TRAINING SUPPORT PACKAGE (TSP)

TSP Number / Title	W221 / MAP READING
Effective Date	01 Oct 2003
Supersedes TSP(s) / Lesson(s)	M207, Map Reading, Nov 99. M207-RC, Map Reading, Jun 01.
TSP Users	400-PLDC, Primary Leadership Development Course. 400-PLDC PH II, Primary Leadership Development Course, Phase II
Proponent	The proponent for this document is the Sergeants Major Academy.
Improvement Comments	Users are invited to send comments and suggested improvements on DA Form 2028, *Recommended Changes to Publications and Blank Forms.* Completed forms, or equivalent response, will be mailed or attached to electronic e-mail and transmitted to: COMDT USASMA ATTN ATSS D BLDG 11291 BIGGS FIELD FT BLISS TX 79918-8002 Telephone (Comm) (915) 568-8875 Telephone (DSN) 978-8875 E-mail: atss-dcd@bliss.army.mil
Security Clearance / Access	Unclassified
Foreign Disclosure Restrictions	FD5. This product/publication has been reviewed by the product developers in coordination with the USASMA foreign disclosure authority. This product is releasable to students from all requesting foreign countries without restrictions.

PREFACE

Purpose

This Training Support Package provides the instructor with a standardized lesson plan for presenting instruction for:

Task Number	Task Title
Individual	
071-329-1006	Navigate from one point on the ground to another point while dismounted.

This TSP Contains

TABLE OF CONTENTS

Map Reading
W221 / Version 1
01 Oct 2003

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
400-PLDC	1	Primary Leadership Development Course
400-PLDC PH II	1	Primary Leadership Development Course Phase II

Task(s) Taught(*) or Supported

Task Number	Task Title
Individual	
071-329-1006 (*)	Navigate from one point on the ground to another point while dismounted.

Reinforced Task(s)

Task Number	Task Title
App C, Task 2	Identify topographic symbols on a map.
App C, Task 3	Identify terrain features on a map.
App C, Task 4	Determine Grid Coordinates of a point on a military map.
App C, Task 5	Determine a magnetic azimuth using a lensatic compass.
App C, Task 6	Determine the elevation of a point on the ground using a map.
App C, Task 8	Measure distance on a map.
App C, Task 9	Convert azimuths.
App C, Task 10	Orient a map using a lensatic compass.
App C, Task 11	Orient a map to the ground by map terrain association.
App C, Task 12	Locate an unknown point on a map and the ground by intersection.
App C, Task 13	Locate an unknown point on a map and the ground by resection.
App C, Task 14	Determine direction without a compass.

Academic Hours

The academic hours required to teach this lesson are as follows:

	Resident Hours/Methods
	8 hrs 20 mins / Conference / Discussion
	4 hrs 30 mins / Practical Exercise (Performance)
Test	0 hrs
Test Review	0 hrs
Total Hours:	13 hrs

Test Lesson Number

	Hours	Lesson No.
Testing (to include test review)	1 hr 25 mins	WE03 version 1

Prerequisite Lesson(s)

Lesson Number	Lesson Title
None	

Clearance Access

Security Level: Unclassified
Requirements: There are no clearance or access requirements for the lesson.

Foreign Disclosure Restrictions

FD5. This product/publication has been reviewed by the product developers in coordination with the USASMA foreign disclosure authority. This product is releasable to students from all requesting foreign countries without restrictions.

References

Number	Title	Date	Additional Information
FM 21-31	TOPOGRAPHIC SYMBOLS (REPRINTED W/BASIC INCL C1)	C1, 19 Dec 1968	
FM 3-25.26	MAP READING AND LAND NAVIGATION	20 Jul 2001	
STP 21-1-SMCT	SOLDIER'S MANUAL OF COMMON TASKS SKILL LEVEL 1	01 Jun 2003	DRAFT (App C)
STP 21-24-SMCT	SOLDIER'S MANUAL OF COMMON TASKS (SMCT) SKILL LEVELS 2-4	01 Apr 2003	

Student Study Assignments

Before class--

- Read Student Handout 1 (Appendix D) for student assignments.
- Complete the reinforcement training package (RTP) (Appendix D)—issued during inprocessing--and perform the practical exercises and complete the quizzes.
- Turn in the quizzes to your SGL NLT three days prior to the start of lesson W221, Map Reading.

During class--

- Participate in classroom discussion.

After Class--

- Turn in recoverable references after the examination for this lesson.

Instructor Requirements

1:8, SSG, PLDC graduate, ITC and SGITC qualified.

Additional Support Personnel Requirements

Name	Stu Ratio	Qty	Man Hours
None			

Equipment Required for Instruction

ID Name	Stu Ratio	Instr Ratio	Spt	Qty	Exp
441-06 LCD Projection System	1:8	1:1	No	1	No
559359 SCREEN PROJECTION	1:8	1:1	No	1	No
673000T101700 PROJECTOR, OVERHEAD, 3M	1:8	1:1	No	1	No
7110-00-132-6651 CHALKBOARD	1:8	1:1	No	1	No
7110-00-T81-1805 DRY ERASE BOARD	1:8	1:1	No	1	No
*7510-00-161-621 Ruler, Straight Edge	1:1	1:1	No	16	No
7510-01-424-4867 EASEL, (STAND ALONE) WITH PAPER	1:8	1:1	No	1	No
*ACD-AVI-00 COORDINATE SCALE AND PROTRACTOR	1:1	1:1	No	16	No
E63317 COMPASS, LENSATIC	1:8	1:1	No	1	No
*GTA-5-2-1 Grid Coordinate Scale	1:1	1:1	No	16	No
*PEN PENS, ALCOHOL, OR WATER-BASED	1:8	1:1	No	16	No
*SERIES V79 TENINO MAPSHEET, 1:50,000	1:2	1:1	No	8	No
*SERIES Map Sheet, Local Area	1:2	1:1	No	8	No

* Before Id indicates a TADSS

Materials Required

Instructor Materials:

- TSP
- VGTs (17)

Student Materials:

- SH-1, Advance Sheet in Appendix D.
- Reinforcement Training Package SH-4 in Appendix D.
- FM 3-25.26 (SH-2) Map Reading and Land Navigation.
- STP 21-1-SMCT, Skill Level 1, Appendix C (DRAFT).
- STP 21-24-SMCT, Skill Level 2-4, APR 2003.
- Lensatic compass.
- GTA 5-2-12 Coordinate Scale/Protractor.
- 1:50,000 Tenino map.
- 1:50,000 scale map of local STX area.

NOTE: Issued to students during inprocessing.

- Pencil and writing paper.

Classroom, Training Area, and Range Requirements

CLASSROOM (40X40 PER 16 STUDENTS)

Ammunition Requirements

Id	Name	Exp	Stu Ratio	Instr Ratio	Spt Qty
None					

Instructional Guidance

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this lesson and identified reference material.

- PE-1 (Appendix C) contains a Reinforced Training Package (RTP)(SH-4) that students must complete. NCOAs have specific responsibilities outlined in PE-1 and the RTP that they must accomplish to assist the students in completing the training. Issue the RTP to the students during inprocessing, to include all material that support the RTP. **DO NOT** issue the quiz answer sheets attached at the end of the RTP.

- This TSP has special slide presentations for ELOs F, G, and H. The slide presentation walks the students through the ELOs the same as the TSP, using the same verbiage, problems, and solutions as the TSP. Commandants, whose schools have the capability to electronically project a slide presentation, may use the presentations. NCOAs can download the presentations from the USASMA website.

- This TSP has questions to check learning or generate discussion. You may add any questions you deem necessary to bring a point across to the group or expand on any matter discussed.

- You must know the information in this TSP well enough to teach from it, not read from it.

- This TSP presents references at the beginning of some of the paragraphs. This allows you to inform your students of where they should look in the reference to follow your instruction.

- The total instruction time for this TSP is 13 Hours. The TSP allows thirteen hours. Since there are no scheduled breaks in the TSP--due to the numerous practical exercises.

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
/s/Grace Joralmon /t/Joralmon, Grace	CIV	Training Specialist	16 Jul 03
/s/Brian H. Lawson /t/Barnes, Ronnie G.	MSG	Course Chief	16 Jul 03
/s/Brian H. Lawson /t/Lawson, Brian H.	SGM	Chief, NCOES	16 Jul 03
/s/Albert J. Mays /t/Mays, Albert J.	SGM	Chief, CDDD	16 Jul 03

SECTION II. INTRODUCTION

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio is: 1:8
Time of Instruction: 5 mins
Media: None

Motivator

Leaders who can't read a map could cause their soldiers to get injured or killed. Imagine a squad leader whose squad is about to get overrun by the enemy, and he is unable to call for artillery fire because he can't read a map. Picture the medical sergeant having to pick up casualties at a certain location, but he is unable to find them due to his inability to read a map. Think about a supply sergeant delivering water and food to waiting soldiers, but again, he can't find them because he can't read a map.

The ability to read and use a map is an important qualification for every soldier and a necessary skill of every leader. The topographic maps we use provide us with comprehensive information on the existence, location, and distance between ground features. They also indicate variation in land forms, such as the elevation and relief of natural features that could affect us during a tactical operation.

Few factors contribute as much to the survivability of soldiers and their equipment, and to the successful accomplishment of a mission as always knowing where they are and how to get to a designated point.

Terminal Learning Objective

NOTE: Inform the students of the following Terminal Learning Objective requirements.

At the completion of this lesson, you [the student] will:

Action:	Apply map reading skills.
Conditions:	In a classroom and field environment given a 1:50,000 Tenino map, 1:50,000 map of local training area, lensatic compass, GTA 5-2-12 (Coordinate Scale and Protractor), pencil, and paper, SH-2, SH-3, and SH-4.
Standards:	Applied map reading skills to-- • Determine elevation on a map. • Orient a map using a lensatic compass. • Determine direction on a map using a protractor. • Determine polar coordinates. • Convert azimuths using the declination diagram. • Find unknown locations on a map using intersection and resection. IAW STP 21-24-SMCT, STP 21-1-SMCT (Draft), FM 3-25.26 (SH-2), and FM 21-31 (SH-3).

Safety Requirements

None

Risk Assessment Level

Low

Environmental Considerations

NOTE: It is the responsibility of all soldiers and DA civilians to protect the environment from damage.

None

Evaluation

Your SGL will evaluate your map reading skills and land navigation skills by--

- Evaluating your work in the RTP.
- You will take a written examination. The examination will contain questions from this lesson. You must correctly answer 70 percent or more of the questions on the examination to receive a GO.
- Your map reading and land navigation skills during the land navigation performance examination conducted later in the course.
- Your map reading and land navigation skills during the situational training exercise (STX) while you serve in a leadership position.

Instructional Lead-In

This lesson provides you with the map reading skills you need to know to read a map. It also serves as a basis for the lesson you will receive later in the course. You will need the skills taught in this lesson to accomplish the tasks in the land navigation class and perform, not only in the land navigation performance examination, but also in the STX at the end of PLDC.

SECTION III. PRESENTATION

NOTE: Inform the students of the Enabling Learning Objective requirements.

A. ENABLING LEARNING OBJECTIVE

ACTION:	Review reinforcement training package (RTP).
CONDITIONS:	In a classroom and field environment given a 1:50,000 Tenino map, 1:50,000 map of local training area, lensatic compass, GTA 5-2-12 (Coordinate Scale and Protractor), pencil, paper, SH-2, SH-3, and SH-4.
STANDARDS:	Reviewed the reinforcement training package (RTP) IAW STP 21-24-SMCT, STP 21-1-SMCT (Draft), FM 3-25.26, and FM 21-31.

1. Learning Step / Activity 1. Review the RTP.

Method of Instruction: Practical Exercise (Performance)
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 4 hrs 30 mins
Media: Reinforcement Training Package (RTP)

NOTE: The RTP is in App D as SH-4.

NOTE: The SGLs will utilize this time to review and go over the practical exercise/reinforcement training package (RTP) completed and turned in by the students. SGLs should take the results of the quizzes to determine the strengths and weaknesses of each student. Based on the results of the quizzes and his/her assessment, the SGL can prepare any special training for each student and possibly the entire class. The SGL will conduct hands on training to ensure mastery of the map reading skills necessary for the students to successfully complete this lesson. There are no breaks scheduled during this 4.5 hour ELO. The SGL should schedule the breaks at appropriate times.

CHECK ON LEARNING: The classroom review of the RTP serves as a check on learning for this ELO.

B. ENABLING LEARNING OBJECTIVE

ACTION:	Determine elevation on a map.
CONDITIONS:	In a classroom and field environment given a 1:50,000 Tenino map, 1:50,000 map of local training area, lensatic compass, GTA 5-2-12 (Coordinate Scale and Protractor), pencil, paper, SH-2, SH-3, and SH-4.
STANDARDS:	Determined elevation on a map IAW FM 3-25.26 and FM 21-31.

1. Learning Step / Activity 1. Determine elevation on a map

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr 30 mins
Media: VGT-1 thru VGT-9

Ref: FM 3-25.26 (SH-2), pp SH-2-64 thru SH-2-74, para 10-1 through 10-5

Determine Elevation

Elevation and relief of terrain greatly affect the deployment of units. Elevation and relief limit the routes of travel and the speed of movement. They also determine how easy or difficult it is to attack, defend, or establish a base for support operations. To aid in the selection and use of terrain, mapmakers developed several symbols and methods for identifying and determining elevation and relief on a map. These symbols/methods are spot elevations, bench marks, contour lines, form lines, hachures, shaded relief, and layer tinting. During this class we will discuss spot elevations, bench marks, and contour lines to determine elevation.

Spot Elevations and Bench Marks

Ref: FM 3-25.26 (SH-2), p SH-2-68 , para 10-3i, and FM 21-31 (SH-3), pp SH-3-2 and SH-3-3, Chapter 2, Figures 228 through 230

Mapmakers use bench marks and spot elevations, in addition to contour lines, to indicate points of known elevations on the map.

Maps show spot elevations, by a brown X usually located at road junctions and on hilltops and other prominent terrain features. If the elevation appears in black numerals, it is a checked for accuracy spot; if it is brown, it is an unchecked accuracy spot.

NOTE: Refer students to the Tenino map legend for examples of spot elevations. Note the colors: black (checked) and brown (unchecked).

Bench mark symbols are a more accurate way to identify elevation. They represent elevation control points. Your Tenino map depicts how mapmakers refer to bench marks in two ways, monumented or non-monumented. Mapmakers symbolize them by a black X, such as $^{\mathbf{BM}}X_{214}$ (monumented). The 214 indicates that the

center of the X is at an elevation of 214 units of measure (feet, meters, or yards) above mean sea level. To determine the units of measure, refer to the contour interval in the marginal information.

NOTE: Refer students to the Tenino map legend for examples of bench marks. Note that the legend identifies two types of bench marks. Monumented **BM** X_{246}, and non-monumented X 301.

NOTE: Explain to the students the difference between monumented and non monumented bench marks. Direct the students to : FM 21-31(SH-3), pp SH-3-2 and SH-3-3, Chapter 2, Figures 228 through 230.

NOTE: Ask the class the following questions and have them work them out on their Tenino map. Select a student to answer the question.

QUESTION: What is the spot elevation indicated at grid EG097863, and is it a checked or unchecked spot elevation?

ANSWER: 74 meters, unchecked.

Ref: Tenino map legend

QUESTION: What is the spot elevation indicated at grid EG186902, and is it a checked or unchecked spot elevation?

ANSWER: 109 meters, checked.

Ref: Tenino map legend

QUESTION: What is the bench mark elevation in grid EG079874, and is it a monumented or non-monumented bench mark?

ANSWER: 83 meters, monumented.

Ref: Tenino map legend

QUESTION: Explain what the following bench mark means: $^{BM}\mathbf{X}_{810}$

ANSWER: The BM indicates there is a tablet on the ground where surveyors measured the elevation, the X (in the center) is the point of measure of elevation, and the 810 is the measure, in this instance meters. So the bench mark is a monumented bench mark showing the elevation at 810 meters.

Ref: FM 3-25.26 (SH-2), p SH-2-68, para 10-3i(1), and FM 21-31 (SH-3), p SH-3-2, Figures 228

Horizontal Control Stations

Horizontal control stations, also called survey control points, are another method of determining elevation. The exact elevation and grid coordinates of these

points are in special books called trig lists. Surveyors mainly use these points, and they are of little use to us.

NOTE: Refer students to map legend to identify symbols. Then, refer them to grid EG161825 and EG055981 for examples of horizontal control stations.

We are discussing these survey control points because sometimes a horizontal control station and a bench mark represent the same point. In this case, the map uses the symbol for the horizontal control station for the point, but it has the description of a monumented bench mark. Lets look at an example.

NOTE: Refer students to grid EG17959825 for an example.

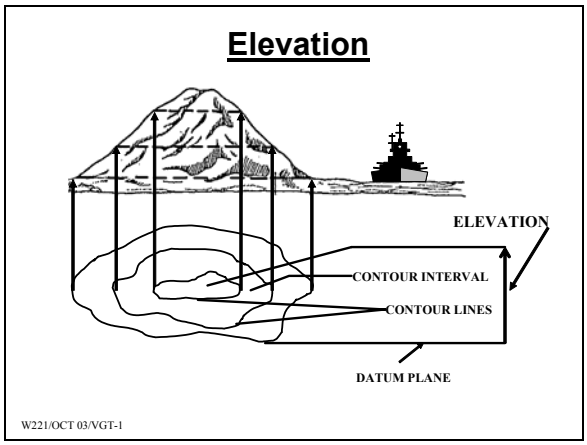
Contour Lines

Ref: FM 3-25.26 (SH-2), p SH-2-64), para 10-2

Military maps primarily show relief and elevation on a map by contour lines. Contour lines show only approximate elevations. You can find the value of contour intervals in the map margin. Standard 1:50,000 military maps use contour intervals of 20 meters. Using the values of contour lines and intervals in conjunction with known elevations, such as the ones we discussed, will enable you to quickly determine the approximate elevation of any point of terrain on the map.

Understanding how to use contour lines enables you to determine the general slope of the ground and visualize terrain features in three-dimensional forms. Let's discuss some terms which will help you visualize how contour lines represent terrain features.

SHOW VGT-1, ELEVATION



Datum Plane: There must be a reference from which you make vertical measurements (up and down). This reference or start point for vertical measure of elevation on a standard military map is the datum plane or sea level--the point halfway between high tide and low tide.

Elevation: The vertical distance of a point on the earth's surface above or below mean sea level.

Relief: The representation (as depicted by the mapmaker) of the shapes of hills, valleys, streams, or terrain features on the earth's surface.

Contour line: A line on a map representing an imaginary line on the ground along which all points are of equal elevation.

Contour interval: The measurable vertical distance between adjacent contour lines.

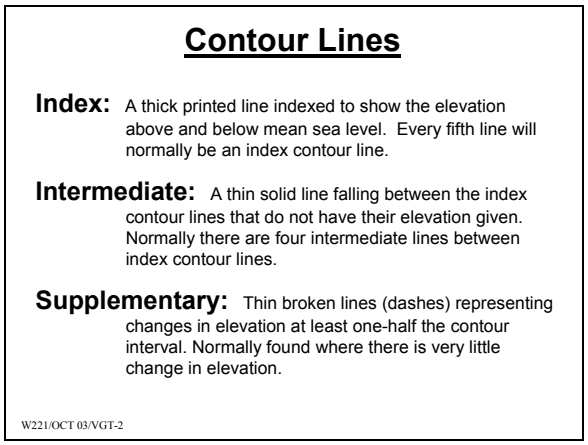
REMOVE VGT-1

Ref: FM 3-25.26 (SH-2), p SH-2-64, para 10-2 e(1-3)

Contour lines are the most common method of showing relief and elevation on a standard topographic map. A contour line represents an imaginary line on the ground, above or below sea level. All points on the contour line are at the same elevation. The elevation represented by contour lines is the vertical distance above or below sea level. The three types of contour lines used on a standard topographic map are index, intermediate, and supplementary.

NOTE: Cover the VGT. Call on students to give the definition of each contour line and have them draw an example on the board. After each student explains one of the contour lines and draws an example on the board, uncover the slide showing the correct answer.

SHOW VGT-2, CONTOUR LINES



REMOVE VGT-2

Contour Intervals

Ref: FM 3-25.26 (SH-2), p SH-2-65, para 10-3

Before determining any point on the map, you must know the contour interval for the map you are using. You can find the contour interval in the marginal information. It is the vertical distance between adjacent contour lines.

NOTE: Ask the students to tell you the unit of measure for elevation on the Tenino map, what the contour interval is, and where they found the information on the map.

The Tenino map depicts elevation in meters, and the contour interval is 20 meters with the supplementary contours of 10 meters. The information in under the scale in the center of the lower margin of the map.

Determine Elevation With Contour Lines

Ref: FM 3-25.26 (SH-2), p SH-2-65), para 10-3

We can use contour lines and contour intervals to determine elevation. To make it easier to understand, we will break the process down into six steps to help you determine elevation.

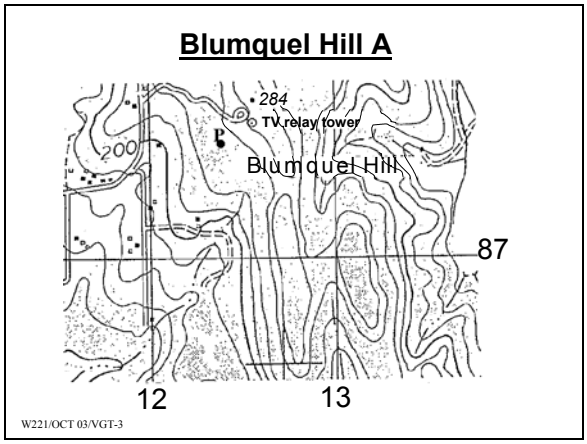
NOTE: Instruct the students to take out their Tenino map and their GTA 5-2-12, Coordinate Scale and Protractor. They will need them as you walk them through a six-step process to determine elevation.

Step 1: Determine the contour interval and supplementary contour line values of the map by referring to the marginal information. As you determined earlier, the map

shows elevation in meters, the contour interval is 20 meters, and the supplementary interval is 10 meters.

NOTE: Show VGT-3, and direct the students to their Tenino map. The area on the VGT is on the Tenino map from which the students will work.

SHOW VGT-3, BLUMQUEL HILL A



Step 2: Identify and mark a point on the map for which you wish to find the elevation. The point we will use in this example is at grid EG12358762. It is marked as point "P" on the VGT.

NOTE: Write the coordinates on the blackboard and have the students select and mark the point on their Tenino map.

Step 3: Find and identify the closest index contour line to your point.

QUESTION: What is the value of the closest index contour line to the point in question?

ANSWER: 200 meters.

NOTE: Point out the closest index contour line on the VGT.

Step 4: Total the number of intermediate contour lines that you must cross to go from the index line you selected, to the point in question.

NOTE: Use the VGT to show how to move from an index contour line across intermediate contour lines to the point to which you need to determine the elevation.

QUESTION: How many intermediate contour lines did you cross to get to the point in question?

ANSWER: Two.

Step 5: The value of the contour interval (20 meters) multiplied by the number of lines crossed, equals the difference in elevation between the index contour line and the closest intermediate contour line to the point in question.

QUESTION: What is the difference in elevation between the index contour line and the point in question?

ANSWER: 40 meters.

Step 6: The last step is to interpolate, or in other words, “estimate” what the difference in elevation from the closest intermediate contour line is to your point. For example, if the point is half way between two intermediate contour lines, add 1/2 the value of the contour interval to your elevation.

Consider all points less than one-fourth the distance between the contour lines to be the same elevation as the closest contour line. A "rule of thumb" to use in determining the elevation of a hilltop is to take the elevation of the last closed contour line and add to it one-half the contour interval. To determine the elevation of a depression, subtract one-half the contour interval from the last depression contour line. Estimating elevation to one-half contour interval for points between contour lines, tops of hills, and depressions satisfies most military needs.

QUESTION: What is the elevation to your point after you interpolate?

ANSWER: 250 meters.

NOTE: Work the following example on the chalkboard to review the process of determining elevation.

Example: Contour interval is 20 meters.

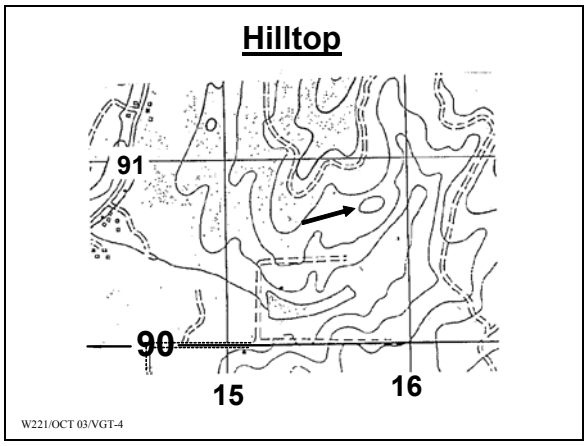
Value of index contour line:	200 meters
Number of lines crossed meters:	2 x 20 = 40
Interpolation is 1/2 the contour interval :	10 meters
Elevation:	= 250 meters

REMOVE VGT-3

Let's work another exercise in determining elevation that is a little more difficult. In this example you will see that you can also determine elevation by subtracting from the closest index contour line.

NOTE: Tell students to find the hill top at grid EG158907 on their Tenino map.

SHOW VGT-4, HILLTOP



By analyzing the terrain and contour lines, you can see that the point of unknown elevation is a hilltop, but at a lower elevation (down slope) than the index contour line.

To determine the elevation of the point, because you cross two intermediate contour lines to get to the hilltop, subtract the 40-meter difference from the 200-meter value of the index contour line. The hilltop lies between the 160 meter and 140 meter intermediate contour line. A contour line indicating a hilltop has the same value as the higher contour line, because you are going up to the small hill top. Remembering the rule of thumb, you must add 1/2 the contour line to arrive at the center of the hilltop.

QUESTION: What is the elevation of the point selected?

ANSWER: 170 meters

NOTE: Work the following example on the chalkboard as you review how to determine the elevation.

Example: Contour interval is 20 meters.

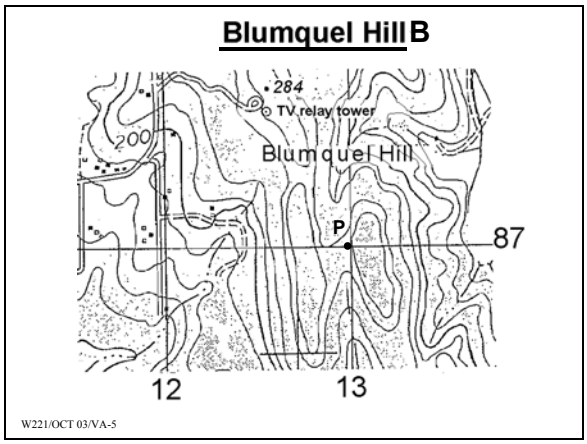
Value of index contour line:	200 meters
Number of lines crossed (downhill):	2 x 20 = 40 meters
Hilltop contour line is same elevation as higher contour line:	= 0
Rule of thumb for hilltops adds 1/2 contour line:	= +10 meters
Elevation:	= 170 meters

REMOVE VGT-4

Let's work one more example for determining elevation. This point is another example where you have to be very careful that you correctly count the number of contour lines that you cross.

NOTE: Have students find the point at grid coordinate EG 130870 on their Tenino map.

SHOW VGT-5, BLUMQUEL HILL B



By analyzing the terrain, you can see that the point of unknown elevation is in a saddle.

QUESTION: What is the elevation for the point selected?

ANSWER: 280 meters. The point is three-quarters or more towards the next higher contour line; therefore, you consider the elevation of the point to be the same as the elevation of the higher contour line.

Ref: FM 3-25.26 (SH-2), p SH-2-67, para 10-3g(3)

REMOVE VGT-5

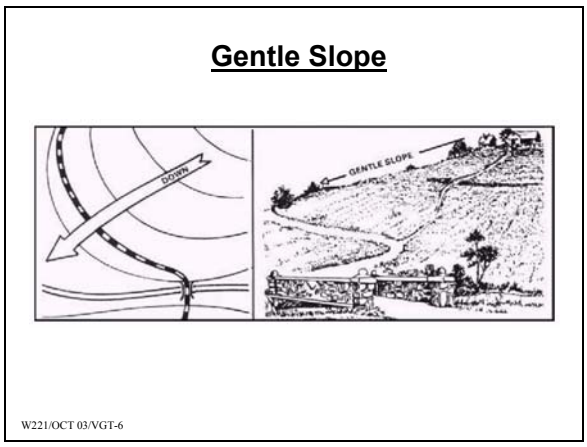
Determine Types of Slopes and Their Elevation

Ref: FM 3-25.26 SH-2, p SH-2-68, para 10-4,

You can determine types of slopes from the map by studying the contour lines--the closer the contour line, the steeper the slope; the farther apart the contour line, the gentler the slope. There are four types of slopes that concern the military.

NOTE: Show VGT-6 and explain the meaning of a gentle slope while the class studies the VGT. Do the same for VGTs 7, 8, and 9.

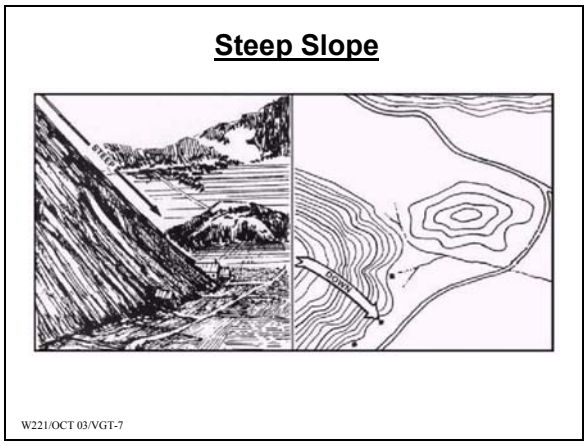
SHOW VGT-6, GENTLE SLOPE



1. Gentle slope: Contour lines show a uniform gentle slope, evenly spaced and wide apart. Considering relief only, a uniform, gentle slope allows the defender to use grazing fire. The attacking force has to climb a slight incline.

REMOVE VGT-6

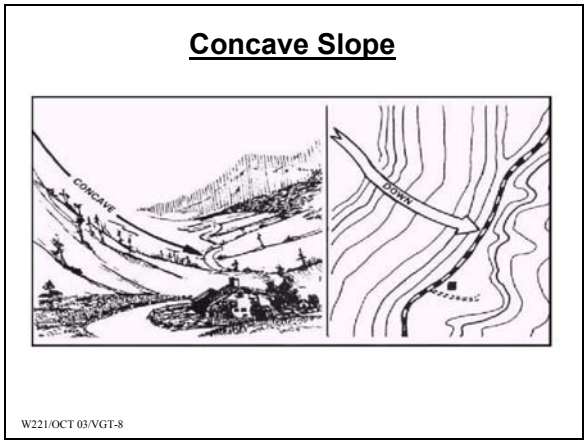
SHOW VGT-7, STEEP SLOPE



2. Steep slope: The map will depict the steep slope with the contour lines uniform and evenly spaced. The closer the contour line the steeper the slope. Considering relief only, a uniform, steep slope allows the defender to use grazing fire, and the attacking force has to negotiate a steep incline.

REMOVE VGT-7

SHOW VGT-8, CONCAVE SLOPE



3. Concave slope: The map depicts the contour lines closely spaced at the top of the terrain feature and widely spaced at the bottom. Considering relief only, the defender at the top of the slope can observe the entire slope and the terrain at the bottom, but he cannot use grazing fire. The attacker would have no cover from the defender's observation of fire, and his climb would become more difficult as he goes farther up the slope.

REMOVE VGT-8

SHOW VGT-9, CONVEX SLOPE

Convex Slope

W221/OCT 03/VGT-9

4. Convex slope: The map shows the contour lines as widely spaced at the top and closely spaced at the bottom. Considering relief only, the defender at the top of the convex slope has a small distance of grazing fire, and he can't observe most of the slope or the terrain at the bottom. The attacker has concealment on most of the slope and an easier climb as he nears the top.

REMOVE VGT-9

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

NOTE: Tell the students to get out their Tenino Maps.

Let's practice what you just learned. Identify the types of slopes at the following grid coordinates on your Tenino map or answer questions.

QUESTION: Identify the type of slope that runs from grid EG171844 northeast to Salmon Creek at grid EG175847.

ANSWER: Steep slope.

Ref: FM 3-25.26 (SH-2), p SH-2-69, para 10-4b

QUESTION: Identify the type of slope that runs from grid EG11708765 to EG11008765.

ANSWER: Gentle slope.

Ref: FM 3-25.26 (SH-2), p SH-2-68, para 10-4a

QUESTION: How do mapmakers depict a concave slope on a map?

ANSWER: They place the contour lines closely spaced at the top of the terrain feature and widely spaced at the bottom.

Ref: FM 3-25.25 (SH-2), p SH-2-69, para 10-4c, figure 10-7

QUESTION: How do mapmakers depict a convex slope on a map?

ANSWER: They draw the contour lines spaced widely at the top and close at the bottom.

Ref: FM 3-25.26 (SH-2), p SH-2-70, para 10-4d

C. ENABLING LEARNING OBJECTIVE

ACTION:	Orient a map using a lensatic compass.
CONDITIONS:	In a classroom or field environment given a 1:50,000 map of the local area, GTA 5-2-12 Coordinate Scale and Protractor, pencil, and lensatic compass and SH-2 and SH-3.
STANDARDS:	Oriented a map to the ground using a compass so that the north-seeking arrow on the compass was within 3 degrees of the angle shown on the grid-magnetic (G-M) angle of the declination diagram shown on the local map IAW FM 3-25.26.

1. Learning Step / Activity 1. Orient a map using a lensatic compass.

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr
Media: None

NOTE: Give a ten minute break approximately every 50 minutes.

Orient a Map with a Lensatic Compass

Ref: FM 3-25.26 (SH-2), p SH-2-75, para 11-1a

NOTE: Weather allowing, conduct this class outside. Provide the students with a map of the local area so when you cover this material in class they can perform the tasks on their maps. Recommend you mount maps on a board so students can lay the map on the ground making it easier to work their compass.

Your first step as a navigator in the field is to orient your map. You will orient your map when it is in a horizontal position with its north and south corresponding to the north and south on the ground.

You learned during skill level training how to orient your map by terrain association. Now you will learn the two techniques to orienting your map with a lensatic compass. Take out your SH-2, Chapter 11, p SH-2-75.

Since you are orienting your map with a compass, remember that the compass measures magnetic azimuths. Therefore, you must pay special attention to the declination diagram because the magnetic arrow points to magnetic north. As mentioned, there are two techniques to orienting your map with a compass.

1. First Technique: Determine the direction of the declination and its value from the declination diagram.

NOTE: Call on a student to provide the G-M angle and to identify if it is a western declination or eastern declination.

a. Place the map in a horizontal position.

b. Open your compass and place the straight edge of the compass alongside a north-south grid line with the cover of the compass pointing toward the top of the map.

NOTE: Check to see if students have lined up their compasses properly.

c. Keeping the compass aligned as explained, rotate the map and compass together until the magnetic arrow is below the fixed black index line on the compass. You are now close to orient your map.

NOTE: Check to see if the students have their maps and compasses oriented properly to this point.

d. This is the point where you must know the declination diagram your map.

(1) If the magnetic north arrow on the MAP is to the left (west) of the grid north line, rotate the map and compass to the right. When the compass reading is equal to the G-M angle given in the declination diagram, you have oriented your map. (See Figure 11-1, SH-2, p SH-2-76).

(2) If the magnetic north arrow on the map is to the right (east) of the grid north line, rotate the map and compass to the left. When the compass reading is equal to 360 degrees minus the G-M angle given in the declination diagram, you oriented your map correctly. (See Figure 11-2, SH-2, p SH-2-7).

NOTE: Check to see if the students oriented their maps properly.

2. Second Technique: Determine the direction of the declination and its value from the declination diagram.

a. Using any north-south grid line on the map as a base, draw a magnetic azimuth equal to the G-M angle given in the declination diagram with a protractor.

b. If the declination is easterly (right) or westerly (left), draw the line in the same direction and on the same G-M angle.

c. Align the straight edge of the compass--left side--alongside the drawn line on the map.

d. Rotate the map and compass until the magnetic arrow of the compass is below the fixed black index line. Once done, you have oriented your map. See Figures 11-3 and 11-4, SH-2, p SH-2-77 and SH-2-78.

NOTE: Check to ensure the students have their maps properly oriented them.

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

QUESTION: You do not have a protractor, so you must use the first technique of orienting you map with a compass. You have aligned the straight edge of the compass along a north-south grid line on the map. What is your next step?

ANSWER: Rotate the map and compass until the magnetic arrow is below the fixed black index line on the compass.

Ref: FM 3-25.26 (SH-2), p SH-2-75, para 11-1a(1)(b)

QUESTION: Once the compass shows that the magnetic arrow is below the fixed back index line on the compass, and the declination diagram shows a westerly magnetic north, what is your next step to orient your map?

ANSWER: Rotate the map and compass together to the right until the compass reading is equal to the G-M angle given in the declination diagram.

Ref: FM 3-25.26 (SH-2), p SH-2-75, para 11-1(d)

QUESTION: If you must rotate your map to the left because you have an easterly G-M angle, what should the reading on your compass be if you properly oriented your map?

ANSWER: 360 degrees minus the declination angle, e.g., a map with 10 degrees easterly G-M angle, the compass should read 350 degrees.

Ref: FM 3-25.26 (SH-2), p SH-2-75, para 11-1a(1)(e)

D. ENABLING LEARNING OBJECTIVE

ACTION:	Determine direction on a map.
CONDITIONS:	In a classroom environment, given a 1:50,000 Tenino Map, GTA 5-2-10 Coordinate Scale and Protractor and SH-2 and SH-3.
STANDARDS:	Determined directions on a map using grid azimuths IAW FM 3-25.26.

1. Learning Step / Activity 1. Determine direction on a map

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr
Media: VGT-10 and VGT-11

NOTE: Give a 10 minute break where appropriate--approximately every 50 minutes.

Determine Direction

Ref: FM 3-25.26 (SH-2), p SH-2-32, Chapter 6

If asked for the direction to a place far away, your responses would vary. This variation indicates that there is a difference in "accuracy" in the directions. We normally express directions as "right," "left," or "straight ahead." In the military though, we rely on exact directions, and therefore we require a much better method of determining direction.

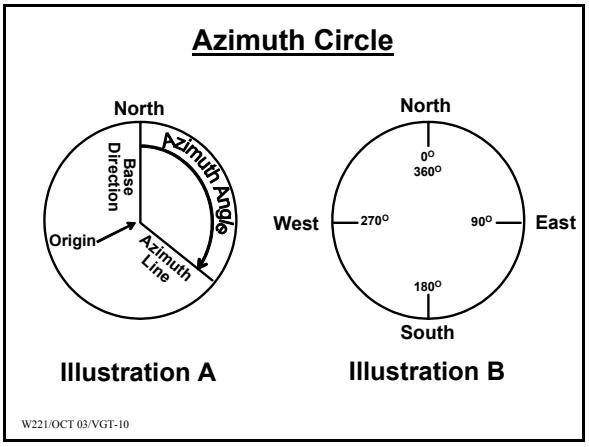
The dictionary defines direction as: "A line or course on which something moves or is aimed to move, or along which something points or faces." In map reading, you express the term "direction" as azimuth.

QUESTION: How would you define azimuth?

ANSWER: An azimuth is a horizontal angle that you measure clockwise from a north base line.

Ref: FM 3-25.26 (SH-2), p SH-2-33, para 6-3

SHOW VGT-10, AZIMUTH CIRCLE



All azimuths originate from the center of an imaginary circle called the azimuth circle.

Illustration "A" shows that the origin of the azimuth line is the center of the circle. You measure the horizontal angle clockwise from the base direction of north to the azimuth line. When working on a map, you normally measure azimuths in degrees or mils.

Illustration "B" shows the same azimuth circle divided into degrees. Notice that north is zero or 360 degrees, east is 90 degrees, south is 180 degrees, and west is 270 degrees.

QUESTION: What is another (more accurate) measurement that you can use for determining azimuths?

ANSWER: Mils.

FM 3-25.26 (SH-2), p SH-2-32, para 6-1b

Artillery, tank, and mortar gunnery units mainly use the mil. It expresses the size of an angle formed when dividing a circle into 6,400 angles with the vertex of the angles at the center of the circle. You can establish a relationship between degrees and mils. A circle equals 6,400 mils or 360 degrees. Dividing the 6,400 mils by 360 degrees equals 17.78 mils per degree. To convert degrees to mils, multiply degrees by 17.78

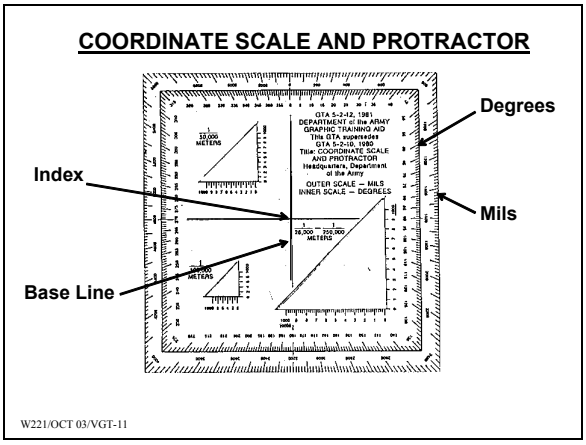
REMOVE VGT-10

QUESTION: What instrument do you use in map reading to determine both mils and degree measurements?

ANSWER: Military protractor, GTA 5-2-12.

Ref: FM 3-25.26 (SH-2), p SH-2-36, para 6-5a

SHOW VGT-11, COORDINATE SCALE AND PROTRACTOR



The protractor represents the azimuth circle. The outer scale is in mils and the inner scale is in degrees. We will concentrate on the inner scale that is in degrees. It is graduated from zero to 360 degrees. Small tick marks represent one-degree increments and the larger tick marks represent five- degree increments. The line located in the center of the protractor from zero (at the top) to 180 degrees (at the bottom) is the base line. The index or center of the protractor is the point of intersection of the base line and the line extending from 90 degrees to 270 degrees.

When measuring azimuths, be sure you properly align the protractor on the map. Orient the base line of the protractor parallel to a north-south grid line on the map. The zero or 360 degrees end of the protractor must always be pointing north (to the top) of the map.

To correctly determine a grid azimuth, you must:

Step 1: Select and mark two separate locations on the map.

Step 2: Use a straight edge and a hard, well-sharpened pencil to draw a line from point A to point B.

Step 3: Place the protractor index on the drawn line at a point where the drawn line intersects with a north-south or east-west grid line.

Step 4: If the point you selected (along the drawn line) intersects with the north-south grid line, simply align the vertical line of the index mark with the north-south gridline. If the point intersects with an east-west grid line, align the horizontal line of the index mark with the east-west grid line.

Step 5: Determine the azimuth to your second location by locating the point where the drawn line comes out under the protractor and noting the direction in degrees at this point. Read the numbers to the nearest degree, and interpolate to a 1/2 degree.

REMOVE VGT-11

QUESTION: What is the grid azimuth in degrees from the TV tower in grid square EG1287 to the road junction nearest the pump in grid square EG1688?

ANSWER: 80 degrees.

Ensure you use the complete 8-digit grid coordinates in the next exercise. The grid square contains two bridges.

QUESTION: What is the grid azimuth in degrees from the bridge in grid square EG15038389 to the tower in grid square EG1887?

ANSWER: 39 degrees.

After you draw your azimuth line, it is always best to place your index of the protractor on the grid line that forms the larger angle with the azimuth line. This will give you a more exact point of intersection than if you choose the grid line that forms a shallow angle with your azimuth line. Therefore, if an azimuth line runs in an east-west direction, place the index of the protractor on a north-south grid line. If your azimuth line runs in a north-south direction, place the index of the protractor on an east-west grid line.

In the next example, the azimuth is almost straight north; therefore, you must use an east-west grid line to line up the index of the protractor.

QUESTION: What is the grid azimuth in degrees from the water tower in grid EG097827 to the water tower in grid EG093853?

ANSWER: 352.5 degrees

QUESTION: What is the grid azimuth in degrees from the water tower in grid EG097827 to BM 83 in grid EG080874?

ANSWER: 341 degrees

To measure an azimuth in mils, you must follow the same procedure with the exception that you must read the outer scale. The outer scale has graduated short tick marks representing 20 mils and long tick marks representing 100 mils. Every other long tick mark has a number, i.e. 0, 200, 400...6200.

QUESTION: What is the grid azimuth in mils from BM 83 in grid EG080874 to spot elevation 167 in grid square EG0784?

ANSWER: 3520 Mils.

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

Conduct a check on learning by clarifying any questions the students may have on how to determine direction on a map. Repeat any of the exercises above to clear up any questions.

E. ENABLING LEARNING OBJECTIVE

ACTION:	Convert azimuths using the declination diagram.
CONDITIONS:	In a classroom environment given a 1:50,000 Tenino Map, GTA 5-2-12 Coordinate Scale and Protractor, paper, pencil and SH-2 and SH-3.
STANDARDS:	Converted grid azimuths to magnetic azimuths and magnetic azimuths to grid azimuths using the declination diagram IAW FM 3-25.26.

1. Learning Step / Activity 1. Convert azimuths using the declination diagram.

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr
Media: VGT-12 thru VGT-16

NOTE: Give 10 min breaks where appropriate--approximately every 50 min.

Converting Azimuths

Ref: FM 3-25.26 (SH-2), p SH-2-33, Chapter 6, para 6-3

Earlier in the lesson you learned how to measure a distance between two points and plot an azimuth to determine polar coordinates. Every time you use a protractor to plot or measure azimuths on a map, you are working with grid azimuths. When in the field, the only instrument that you have available to measure azimuths is a magnetic compass. The azimuth we obtain with a magnetic compass is a magnetic azimuth. In this part of the lesson, you will learn about the different types of azimuths and how to convert a grid azimuth into a magnetic azimuth and vice versa.

As you know, you determine an azimuth by measuring a horizontal angle in a clockwise direction from a base line. There are three different base lines: true north, magnetic north, and grid north.

QUESTION: How does the Army define true north?

ANSWER:
- It is a line from any position on the earth's surface to the north pole.
- All lines of longitude are true north lines.
- Usually represented by a star.

Ref: FM 3-25.26 (SH-2), p SH-2-32, para 6-2a

QUESTION: How does the Army define magnetic north?

ANSWER:
- The direction to the north magnetic pole.
- The north seeking needle of a lensatic compass points to this location.
- Used in the field when using a magnetic compass.
- Usually symbolized by a line ending with half of an arrowhead.

Ref: FM 3-25.26 (SH-2), p SH-2-32, para 6-2b

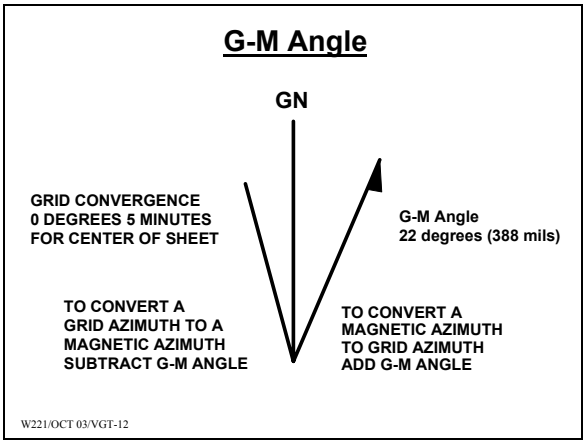
QUESTION: How does the Army define grid north?

ANSWER:
- The north established by using the vertical grid lines on a map.
- The map may symbolize grid north by the letters "GN" or the letter "Y."

Ref: FM 3-25.26 (SH-2), p SH-2-33, para 6-2c

SHOW VGT-12, G-M ANGLE

Ref: FM 3-25.26 (SH-2), p SH-2-38, para 6-6



NOTE: The declination diagram shown on VGT-12 is from an older "Tenino" map sheet with an easterly G-M angle of 22 degrees. The student should understand that angles will change periodically. When working with map sheets, you should note the angular relationship between grid, true, and magnetic north.

This is a declination diagram of a Tenino map sheet. The diagram shows the interrelationship of true, grid, and magnetic north. The G-M angle shows the angular difference in direction between grid and magnetic north. We express the value of the angle in degrees to the nearest 1/2-degree; we express mil equivalents to the nearest 10 mils. Because of this angle difference in grid and magnetic north, you must convert one to the other using the G-M angle before you can use the map azimuth on the ground or the compass azimuth on the map.

Newer map sheets normally have notes next to the declination diagram explaining the use of the G-M angle. One note provides instructions for converting a magnetic azimuth to grid azimuth. The other note provides instructions for converting a grid azimuth to a magnetic azimuth. Always follow the instructions of the notes when converting azimuths.

NOTE: Point out these notes on VGT.

On older map sheets which do not show the notes telling us how to convert, it is necessary to determine whether to add or subtract the G-M angle to convert grid to magnetic azimuths and vice versa.

REMOVE VGT-12

We differentiate between easterly and westerly G-M angles when converting grid azimuths to magnetic azimuths and vice versa. If the magnetic prong is east of the grid prong, then we have an easterly G-M angle. If the magnetic prong is west of the grid north prong, then we have a westerly G-M angle. However, the principle of how to determine if you have to add or subtract the G-M angle stays the same. It turns out that if you add with an easterly G-M angle, then you subtract with a westerly G-M angle and vice versa. Let's look first at an easterly G-M angle.

NOTE: Use the chalkboard to construct an easterly G-M angle of 22 degrees and demonstrate each step as you explain the conversion process.

A rule to remember when solving conversion problems is that: "no matter where the azimuth points, always measure the angle to it clockwise from the base line." With this in mind we may solve the problem in two easy steps.

Step 1: From the base of the G-M angle, draw a line to the right; this line represents any azimuth, grid or magnetic, from 0 to 360 degrees.

NOTE: Draw a line approximately at a right angle.

Step 2: Draw an arc clockwise from grid north to that line and label it "G" for grid arc. Then draw an arc clockwise from magnetic north to that line and label it "M" for magnetic arc.

NOTE: Draw in the two arcs.

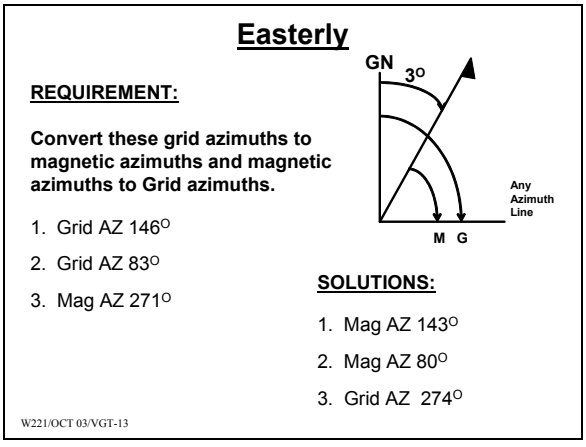
We can see from the diagram that the grid arc is larger than the magnetic arc by the value of the G-M angle. Therefore, if you want to make the grid azimuth look like the magnetic azimuth (convert a grid azimuth to a magnetic azimuth) you must subtract the G-M angle. If you want to make the shorter magnetic arc look like the Grid Arc (convert a magnetic azimuth to a grid azimuth), then you must add the G-M angle. In our example we have a G-M angle of 22 degrees. If you want to convert a grid azimuth of 110 degrees to a magnetic azimuth, what would you have to do? Since the grid arc is larger than the magnetic arc, you have to subtract the G-M angle from the grid azimuth.

NOTE: Write the following azimuth conversion on the blackboard.

Grid azimuth of 110 degrees
G-M angle - 22 degrees
Magnetic azimuth 88 degrees

NOTE: Students must understand the process before working more exercises. Cover the solutions on VGT-13 before showing it to the students.

SHOW VGT-13, EASTERLY



QUESTION: What are the values of the converted azimuths in this VGT?

ANSWER: a. Mag AZ 143^0
b. Mag AZ 80^0
c. Grid AZ 274^0

REMOVE VGT-13

Let's construct a westerly G-M angle in the same manner.

NOTE: Draw a westerly G-M angle of 22 degrees on the blackboard.

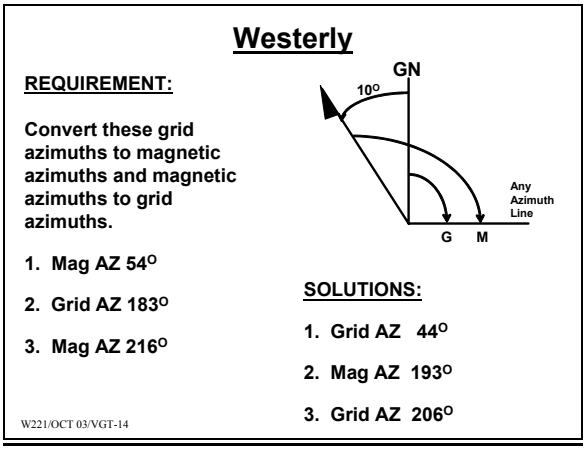
When the magnetic prong is west of the grid prong, then the magnetic arc is larger than the grid arc. Therefore, add the G-M angle to make the grid arc look like the magnetic arc. In other words, you must add the G-M angle if you are converting grid azimuth to magnetic azimuth.

NOTE: Write the following azimuth conversion on the blackboard.

Grid azimuth 110 degrees
G-M angle + 22 degrees
Magnetic azimuth 132 degrees

NOTE: Ensure students understand the process before working more exercises. Cover the solutions on VGT-14 before showing slide to the students.

SHOW VGT-14, WESTERLY



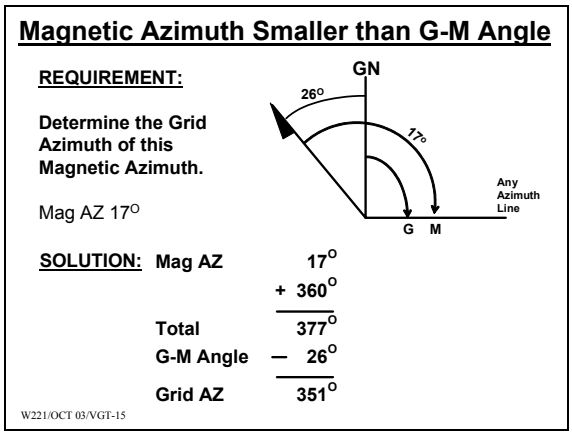
QUESTION: What are the values of the converted azimuths in this VGT?

ANSWER: a. Grid AZ 44^0
b. Mag AZ 193^0
c. Grid AZ 206^0

REMOVE VGT-14

In some cases the G-M angle will be larger than the azimuth you want to convert. When this happens, simply add a full circle (360 degrees) to your azimuth so you will not have negative numbers as shown in the following example.

SHOW VGT-15, MAGNETIC AZIMUTH SMALLER THAN THE G-M ANGLE

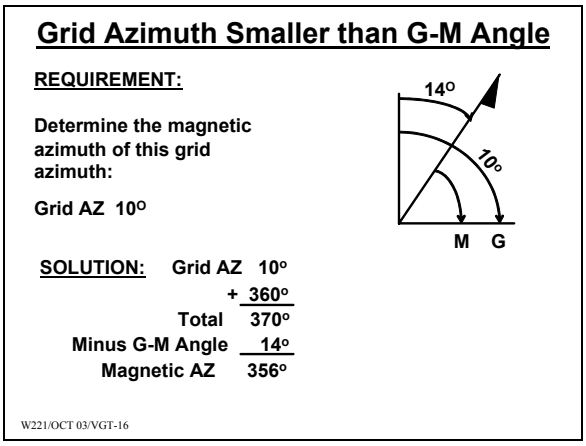


NOTE: Work through the problem. Ensure students understand before moving on.

REMOVE VGT-15

The same thing can happen with the grid azimuth. Again you add a full circle (360 degrees) to the azimuth as shown in this example.

SHOW VGT-16, GRID AZIMUTH SMALLER THAN G-M ANGLE



NOTE: Work through the problem. Ensure students understand before moving on to more exercises.

REMOVE VGT-16

Let's now work a few exercises to ensure that you know how to convert azimuths when the G-M angle is greater than the azimuth we are subtracting from.

QUESTION: If the G-M angle is 19 degrees easterly and the grid azimuth is 18 degrees, what is the magnetic azimuth?

ANSWER: 359 degrees

QUESTION: If the G-M angle is 22 degrees westerly and the magnetic azimuth is 10 degrees, what is the grid azimuth?

ANSWER: 348 degrees

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

Conduct a check on learning by clarifying any questions the students may have on how to Convert azimuths. Repeat any of the exercises above to clear up any questions.

F. ENABLING LEARNING OBJECTIVE

ACTION:	Determine polar coordinates.
CONDITIONS:	In a classroom environment, given a 1:50,000 Tenino Map, 1:50,000 map of the local area, GTA 5-2-12 Coordinate Scale and Protractor, paper, pencil, SH-2 and SH-3.
STANDARDS:	Determined the polar coordinates by plotting an azimuth and a distance from a known point on a map IAW FM 3-25.26.

1. Learning Step / Activity 1. Determine polar coordinates,

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr 10 mins
Media: VGT-17

NOTE: Give 10 min breaks where appropriate--approximately every 50 min.

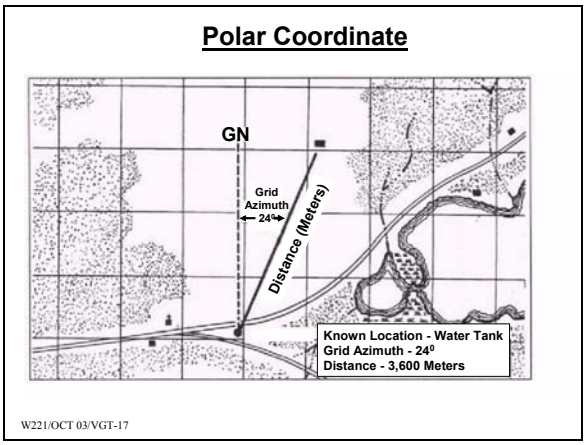
NOTE: SGLs may use the ELO F, Polar Coordinate Powerpoint Presentation to conduct this ELO. You need to download the Powerpoint presentation from the USASMA website.

Determining Polar Coordinates

Ref: FM 3-25.26 (SH-2), p SH-2-50, Chapter 6, para 6-10

Polar coordinate is a method of locating or plotting an unknown position from a known point by giving a direction and a distance along a direction line.

SHOW VGT-17, POLAR COORDINATE



Since you already know how to measure an azimuth and a distance between two points, you will quickly learn how to plot an azimuth and a distance. Let's go through the steps to plot an azimuth from a known point.

Step 1: Place the index mark of the protractor at the center of mass on the known point from which you are measuring, ensuring that the base line (0-180 line) is parallel to a north-south grid line. Your known point will seldom fall directly on a grid line; therefore, it is sometimes difficult to keep the base line parallel with a north-south grid line. Since the north-south grid lines on the map are at a right angle (90 degrees) to the east-west grid lines, and all the vertical and horizontal lines on a protractor are at a right angle, you can use any line on the protractor. That is, you can use the edges of the protractor, degree scale, and horizontal line through the index, to assist you in keeping the protractor parallel to a north-south grid line.

Step 2: Locate the desired azimuth on the protractor scale and place a dot on the map at this azimuth.

Step 3: Remove the protractor and connect the point and dot with a straight line.

The azimuth line you constructed is the direction to your second point. To get the precise location of the point, you must now plot a distance along this azimuth line. Here's how to do that:

Step 1: Select the appropriate scale measurement and place a paper straight edge on the scale.

Step 2: Determine the desired distance to measure from the scale and mark the paper at this distance using tick marks. Mark the distance to the unknown point, along the azimuth line, with the straight edge tick marks.

Step 3: Align the straight edge with the azimuth line. Ensure the first tick mark is center mass on the known point.

Step 4: Place a dot on the map at the second tick mark from the straight edge on the map. The position of the second tick mark is the position of the unknown point. Remove the straight edge and determine the grid coordinate to the second point. We call this procedure "Determining Polar Coordinates." Let's work an example of plotting polar coordinates.

QUESTION: What are the polar coordinates plotted from the horizontal control point "Skook" in grid square EG1682 at an azimuth of 272 degrees and a distance of 3100 meters?

ANSWER: EG130826

QUESTION: What are the polar coordinates plotted from the water tower in grid square EG1185 at an azimuth of 46 degrees and a distance of 2000 meters?

ANSWER: EG12958695

QUESTION: What are the polar coordinates plotted from the water tower in grid square EG1185 at an azimuth of 81 degrees and a distance of 3150 meters?

ANSWER: EG14658605

REMOVE VGT-17

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

Conduct a check on learning by clarifying any questions the students may have on how to Determine polar coordinates.

G. ENABLING LEARNING OBJECTIVE

ACTION:	Locate an unknown point on a map and on the ground by intersection.
CONDITIONS:	In a classroom environment, given a 1:50,000 Tenino map, the location of two known points, a straight edge, a GTA 5-2-12 (Coordinate Scale and Protractor), pencil, paper, and an object or terrain feature for which to determine the grid location.
STANDARDS:	Located the unknown location in a 100,000 meter square with its identification letters and six-digit coordinates to within 100 meters of the actual grid coordinate IAW FM 3-25.26.

1. Learning Step / Activity 1. Locate an unknown point on a map and on the ground by intersection.

Method of Instruction:	Conference / Discussion
Technique of Delivery:	Small Group Instruction (SGI)
Instructor to Student Ratio:	1:8
Time of Instruction:	1 hr 10 mins
Media:	None (See note below)

NOTE: SGLs may use the ELO G, Intersection Powerpoint Presentation to conduct this ELO. They have to download the powerpoint presentation from the USASMA website.

Locate Unknown Point on Map by Intersection

Ref: FM 3-25.26 (SH-2), p SH-2-44, para 6-7

Intersection is a method to determine the location of an unknown point or object by occupying at least two--preferably three--positions and determining the azimuth to the unknown point from these positions. The main purpose of intersection is to determine coordinates to enemy locations. There are two ways to perform an intersection. The primary method is the "map and compass method." The other method is the "map and straight edge method."

The map and straight edge method is much less accurate and you should only use it when a compass is not available. The map and straight edge method requires orientation of the map to the ground.

NOTE: Explain to the students that they will only simulate measuring a magnetic azimuth; they can only perform this step in the field.

We will now perform an intersection using the map and compass method.

NOTE: Have the students perform the steps of an intersection on their maps as you explain the method step-by-step.

Step 1. Orient your map using a compass.

Step 2. Sight the enemy position on the ground.

Step 3. Locate your position on the ground and mark it on the map.

Example: Road junction at EG13508009.

Step 4. Determine the magnetic azimuth from the road junction to the enemy position and convert the magnetic azimuth to a grid azimuth.

Example:	Magnetic azimuth	59 degrees
	Easterly G-M angle	+21 degrees
	Grid azimuth	80 degrees

Step 5. Draw a line from the road junction along that grid azimuth.

NOTE: Explain that it is much better to have a second team positioned at an observation point that can radio the azimuth from its position to the enemy to you. Then you don't have to move to a second location.

Step 6. Move to or call a second known position where you or they can see the enemy and mark that position on the map.

Example: Road junction located at EG13318108.

Step 7. Repeat steps 4 and 5.

Example:	Magnetic azimuth	79 degrees
	Easterly G - M angle	+21 degrees
	Grid azimuth	100 degrees

Step 8. Where the lines cross is the location of the enemy.

Example: Grid EG16218055

Step 9. It is desirable to repeat the procedure from a third point to increase the accuracy.

Example: Road junction at EG15478180.

Magnetic azimuth	128 degrees
Easterly G-M angle	+21 degrees
Grid azimuth	149 degrees

Notice that the lines from the first and second point form a very shallow angle where they intersect. This decreases the accuracy of an intersection. Whenever possible, choose locations that will give you a large angle where the lines intersect. The third location in our example is such a point. Notice the line from that point intersects both of the other lines at a larger angle. This greatly increases the accuracy of the intersection.

Let's work some exercises of intersections and see what accuracy you can achieve. Remember, it is important that you perform the work precisely and that your pencil is sharp.

Your squad occupies two observation posts. The team at the water tower in grid square EG0985 sees the enemy at a magnetic azimuth of 351 degrees. The second team located at the water tower in grid square EG1185 sees the enemy at a magnetic azimuth of 300 degrees.

QUESTION: What is the grid location of the enemy?

ANSWER: Grid coordinate EG09798765.

Your squad is operating as an observation team and you see six enemy helicopters land and then disappear from your sight. Prior to the helicopters disappearing from your sight, you shot a magnetic azimuth to the location where you saw them land. This magnetic azimuth is 316 1/2 degrees. Your location is the bridge in grid square EH1000. You contact your other team located in the Zion Chapel Tower at grid square EH1102. They have a sighting of six enemy helicopters at a magnetic azimuth of 229 1/2 degrees. Both your teams perform an intersection.

QUESTION: What are the grid location and the type of terrain where the six enemy helicopters landed?

ANSWER: Grid EH093022, depression.

The second method of intersection requires orienting the map to the ground and aligning a straight edge with both the known point on the map and the unknown point on the ground. Although this method is not as accurate as the map and compass method, you may use it as an alternate method of intersection when a compass is not available. To use this method you must:

Step 1. Orient the map properly to the ground.

Step 2. Locate your position on the ground and mark your position on the map.

Step 3. Lay a straight edge (e.g., protractor) with one end at your position as a pivot point, then rotate the straight edge until you sight the unknown point (Your selected piece of equipment or soldier) along the edge.

Step 4. Draw a line along the straight edge.

Step 5. Repeat procedures 1 thru 4 at an alternate known position.

Step 6. The intersection of lines is the location of the unknown point.

Step 7. Again, for a check of accuracy, you may use a third position.

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

Conduct a check on learning by clarifying any questions the students may have on how to locate unknown points on a map by intersection. Repeat any of the steps above to clear up any questions.

H. ENABLING LEARNING OBJECTIVE

ACTION:	Locate an unknown point on a map and on the ground by resection.
CONDITIONS:	In a classroom environment, given a 1:50,000 Tenino map, the location of two known and identifiable points on the map, a straight edge, GTA 5-2-12 (Coordinate Scale and Protractor), pencil, paper, SH-2 and SH-3.
STANDARDS:	Located the unknown point in a 100,000 meter square with its identification letters and six-digit coordinates to within 100 meters of the actual grid coordinate IAW FM 3-25.26.

1. Learning Step / Activity 1. Locate an unknown point on a map and on the ground by resection.

Method of Instruction: Conference / Discussion
Technique of delivery: Small Group Instruction (SGI)
Instructor to Student Ratio: 1:8
Time of Instruction: 1 hr 10 mins
Media: None (See note below).

NOTE: SGLs may use the ELO H, Resection Powerpoint Presentation to conduct this ELO. They have to download it from the USASMA webpage.

NOTE: Give 10 min breaks where appropriate--approximately every 50 min**.**

Locate Unknown Point on Map by Resection

Ref: FM 3-25.26 (SH-2), p SH-2-46 thru SH-2-48, para 6-8

Resection is a method to determine the location of an unknown point (your position) by sighting on at least two--preferably three known positions--and determining the azimuth to the unknown point (your location) from these well-defined locations. The main purpose of resection is to determine coordinates to your location. As in "intersection," there are two ways to perform a resection. The primary method is the "map and compass method." The other method is the "map and straight edge method." The map and straight edge method is much less accurate, and you should only use it when a compass is not available. This method requires that you orient the map to the ground.

Resection is very similar to intersection. The main difference is that instead of plotting an azimuth to an unknown point from two or three known locations that you have to occupy, you now plot back azimuths from known positions that you don't have to occupy. Intersection allows you to determine grid coordinates to the enemy without occupying the enemy's position. Resection allows you to determine grid coordinates to your location from known points even if the enemy controls them. In order to do that, you need to understand the term back azimuth.

Ref: FM 3-25.26 (SH-2), p SH-2-34, para 6-3a

Suppose your mission requires you to move along an azimuth of 81 degrees to an alternate position and then return to your present location.

QUESTION: What direction would you follow during your return trip?

ANSWER: You would move along an azimuth of 261 degrees. A back azimuth is simply the opposite of an azimuth and it always differs by exactly 180 degrees. There are two rules you must remember when determining the back azimuth.

Rule 1. If the azimuth is more than 180 degrees, then subtract 180 degrees.

NOTE: Work the example on the blackboard.

Example: Azimuth 215 degrees
-180 degrees
Back azimuth 35 degrees

Rule 2. If the azimuth is 180 degrees or less, then add 180 degrees.

NOTE: Work the example on the blackboard.

Example: Azimuth 180 degrees
+ 180 degrees
Back azimuth 360 degrees

QUESTION: What are the back azimuths of these azimuths? 45, 340, 210, 125, and 15 degrees.

ANSWER: 225, 160, 30, 305, and 195.

Now that you understand what a back azimuth is and how to calculate it, let's return to resection and see how to use the back azimuth.

Ref: FM 3-25.26 (SH-2), p SH-2-46, para 6-8

To use the map and compass method of resection, you must follow these steps:

Step 1. Orient the map using the compass.

Step 2. Locate a feature or object that is identifiable on both the ground and the map and mark the map location.

Example: Tower located at EG18048759

Step 3. Measure the magnetic azimuth to the known position and convert the magnetic azimuth to a grid azimuth.

Example: Mag AZ	29 degrees
G-M angle	+21 degrees
Grid azimuth	50 degrees

Step 4. Change the grid azimuth to a back azimuth and draw a line from the known position backward toward your unknown position.

Example: Grid azimuth	50 degrees
Add	+180 degrees
Grid back AZ	230 degrees

Step 5. Locate a second feature or object that is identifiable on both the ground and the map and mark the map location.

Example: Bridge located at EG15008389.

Step 6. Repeat step 3.

Example: Magnetic azimuth	151 degrees
Add G-M angle	+ 21 degrees
Grid azimuth	172 degrees

Step 7. Repeat step 4.

Example: Grid azimuth	172 degrees
Add	+180 degrees
Grid back AZ	352 degrees

Step 8. The point where the two lines intersect is your location.

Example: EG14858494

Step 9. For a check on accuracy, you should construct a third line following the steps as outlined.

Whenever possible, choose locations which will give you a large angle where the lines intersect. This will increase the accuracy of your resection.

Work some resection exercises and check your accuracy. Remember, it's important to perform the work precisely and that your pencil is sharp.

While on a reconnaissance mission, an enemy scout platoon detects your squad. You take up a defensive position and decide to request indirect fire support. You're not sure of your location. From your location, you can see a lookout tower in grid EG1887 at a magnetic azimuth of 110 degrees and a TV relay tower in grid EG1287 at a magnetic azimuth of 215 degrees.

QUESTION: What is your location?

ANSWER: EG155897.

You determine a distance of 800 meters to the enemy with your laser range finder and a magnetic azimuth of 290 degrees.

QUESTION: What is the grid location of the enemy scout platoon?

ANSWER: EG149902.

You had to remember how to use the polar plot method to find the location of the enemy. Since the enemy pinned you down, it would have been impossible to move to another location and perform an intersection. As you can see, you have to use all the map reading skills in conjunction with each other. Let's work a couple of more resection problems to improve our accuracy.

QUESTION: You determined that the magnetic azimuth from your position to the TV relay tower in grid square EG1287 is 3 degrees and the magnetic azimuth to the spot elevation 199 in grid square EG1385 is 77 degrees. What is the six-digit grid coordinate of your location?

ANSWER: EG116856.

QUESTION: The magnetic azimuth from your location to the water tower at EG093853 is 63 degrees and the magnetic azimuth to the water tower at EG097827 is 104 degrees. What is the six-digit coordinate to your location?

ANSWER: EG063849.

Whenever you do not have a compass available you can use the straight edge method to perform a resection. This requires that you orient the map to the ground and use a straight edge to sight at the known locations. The method remains basically the same. The main difference is that you do not shoot a magnetic azimuth

to the known points. You simply line up a straight edge, just like a rifle sight, to your points. This saves you from converting magnetic azimuth to grid azimuth and also azimuth to back azimuth. Use this method only when a compass is not available since it is not nearly as accurate as the compass method.

CHECK ON LEARNING: Conduct a check on learning and summarize the ELO.

Conduct a check on learning by clarifying any questions the students may have on how to locate unknown points on a map by resection. Repeat any of the steps above to clear up any questions.

SECTION IV. SUMMARY

Method of Instruction: Conference / Discussion
Technique of Delivery: Small Group Instruction (SGI)
Instructor to Student Ratio is: 1:8
Time of Instruction: 5 mins
Media: None

Check on Learning

Ask the students if there are any questions pertaining to what they covered during the last 13 hours of class and practical exercises. The PEs completed during the lesson and the questions asked served as the check on learning.

Review / Summarize Lesson

During the last 13 hours you received reinforcement training in the following tasks through self study and practical exercises. These skills include:

- Identify topographic symbols on a military map.
- Identify terrain features on a map.
- Orient a map to the ground by map terrain association.
- Determine the grid coordinate of a point on a military map.
- Determine a location on the ground by terrain association.
- Determine a magnetic azimuth using a lensatic compass.
- Determine direction using field-expedient methods.
- Measure distance on a map.

The above navigation tasks are absolutely essential, along with the tasks--listed below--in order for you to successfully complete the land navigation performance examination, and to lead a section/squad during the STX later in this course.

- Determine the elevation of a point on the ground using a map.
- Convert azimuths.
- Orient a map using a lensatic compass.
- Locate an unknown point on a map and the ground by intersection.
- Locate an unknown point on a map and the ground by resection.
- Determine an azimuth using a protractor.
- Compute back azimuths.

Transition to Next Lesson

You will now begin using the skills you just reinforced and learned in support of the next lesson, W226, Land Navigation.

SECTION V. STUDENT EVALUATION

Testing Requirements

NOTE: Describe how the student must demonstrate accomplishment of the TLO. Refer student to the Student Evaluation Plan.

- You will take a written examination. The examination will contain questions from this lesson. You must correctly answer 70 percent or more of the questions on the examination to receive a GO. Failure to achieve a GO on the examination will result in a retest. Failure of the retest could result in your dismissal from the course.

- You will take a performance evaluated examination later in the course following W226, Land Navigation, utilizing the skills presented in this lesson. You must navigate a course covering approximately 3200 meters. You must find three of four points to receive a GO. Failure to achieve a GO on the examination will result in a retest. Failure of the retest could result in your dismissal from the course

- Your SGL will also evaluate your ability to read a map and navigate during the end of course STX while you are filling a leadership position.

Feedback Requirements

NOTE: Feedback is essential to effective learning. Schedule and provide feedback on the evaluation and any information to help answer students' questions about the test. Provide remedial training as needed.

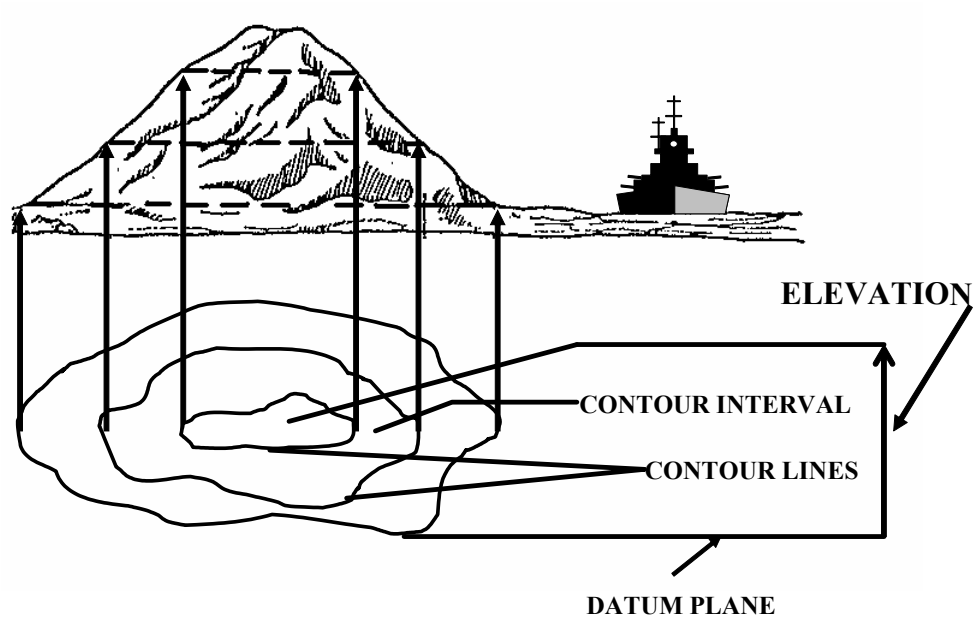
Inform the students where their examination will take place, as posted on the training schedule, and when they will receive feedback on the test. Include any retest information.

Enabling Learning Objective B

Learning Step 1

VGT-1, ELEVATION

Elevation



W221/OCT 03/VGT-1

Contour Lines

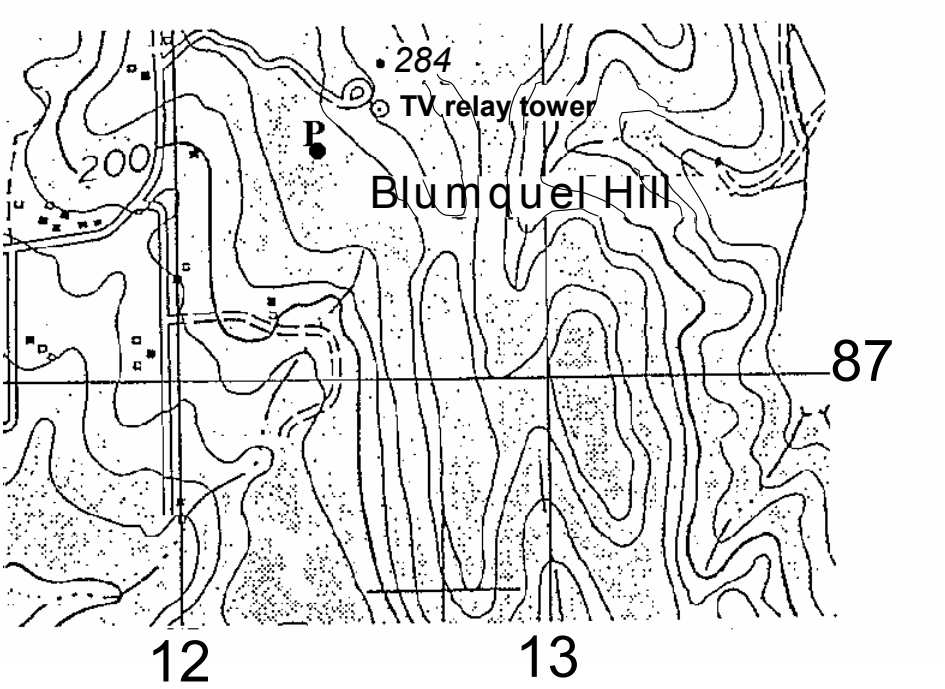
Index: A thick printed line indexed to show the elevation above and below mean sea level. Every fifth line will normally be an index contour line.

Intermediate: A thin solid line falling between the index contour lines that do not have their elevation given. Normally there are four intermediate lines between index contour lines.

Supplementary: Thin broken lines (dashes) representing changes in elevation at least one-half the contour interval. Normally found where there is very little change in elevation.

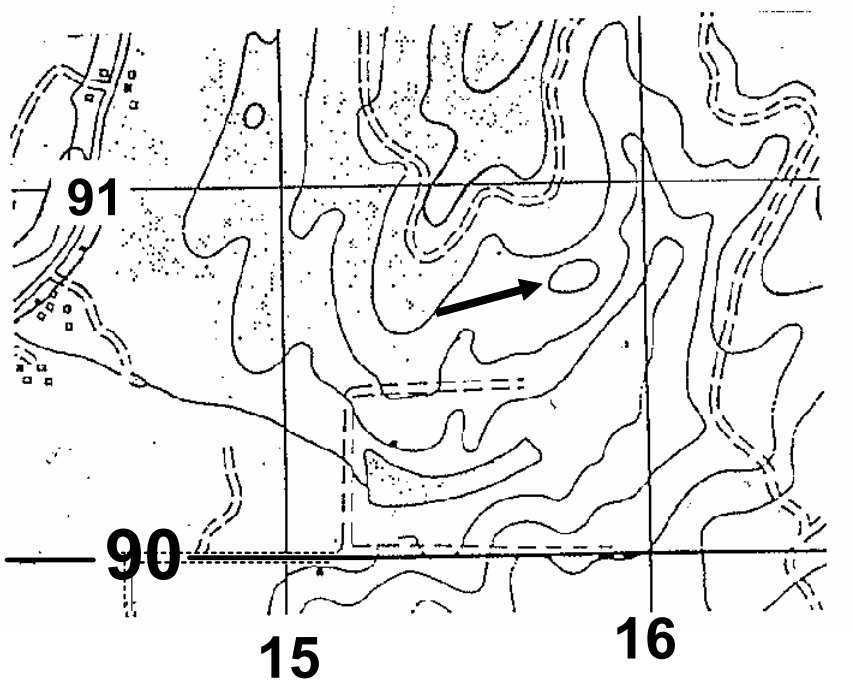
W221/OCT 03/VGT-2

Blumquel Hill A



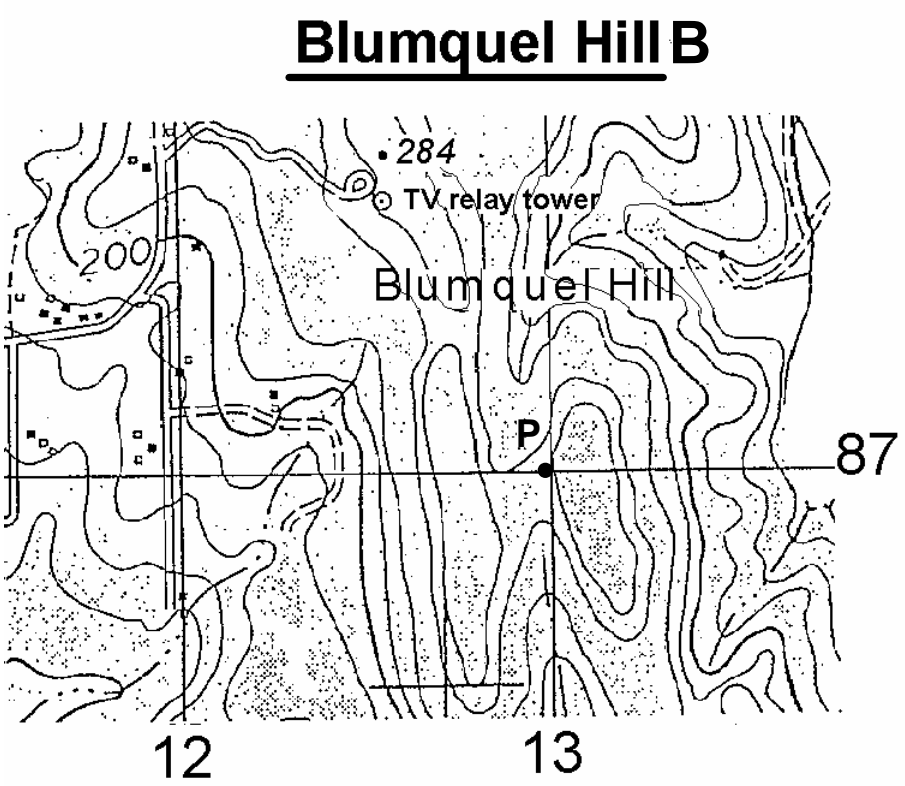
W221/OCT 03/VGT-3

Hilltop



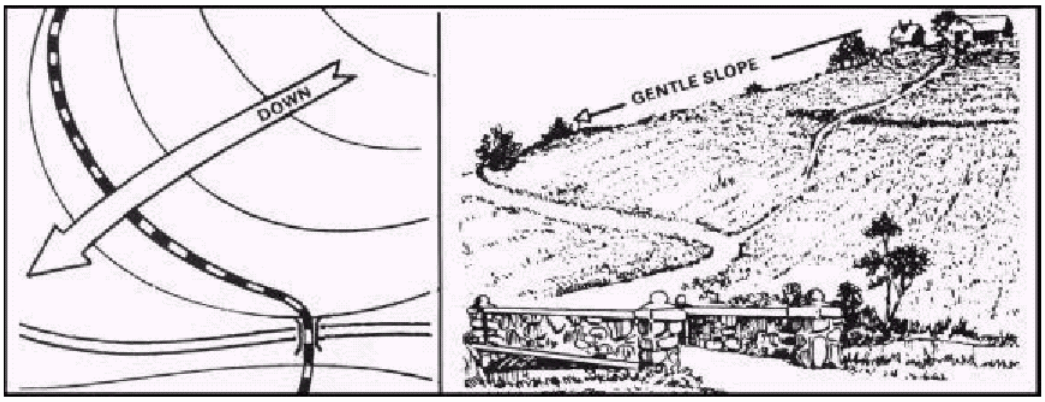
W221/OCT 03/VGT-4

VGT-5, BLUMQUEL HILL B



W221/OCT 03/VGT-5

Gentle Slope

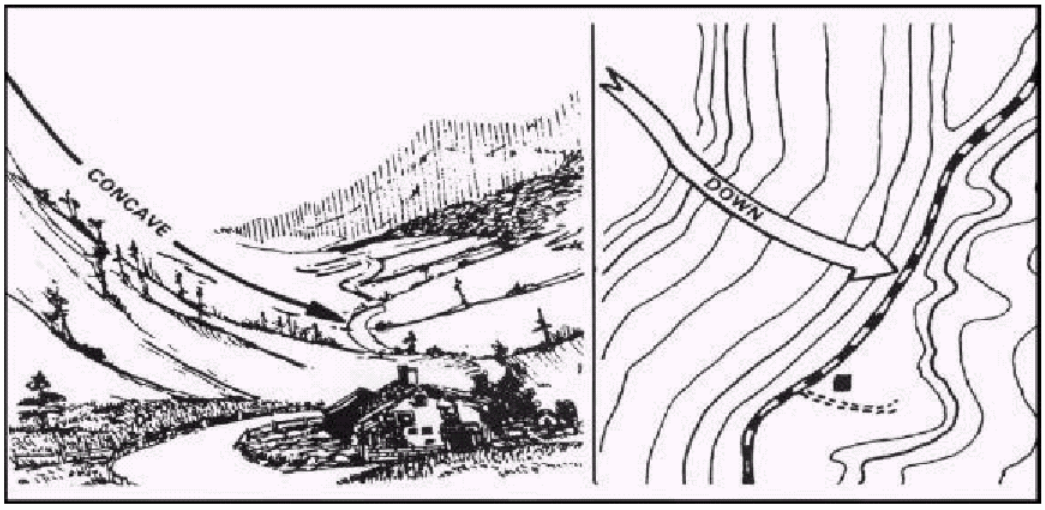


W221/OCT 03/VGT-6

Steep Slope

W221/OCT 03/VGT-7

Concave Slope



W221/OCT 03/VGT-8

Convex Slope

W221/OCT 03/VGT-9

Enabling Learning Objective D

VGT-10, AZIMUTH CIRCLE

Azimuth Circle

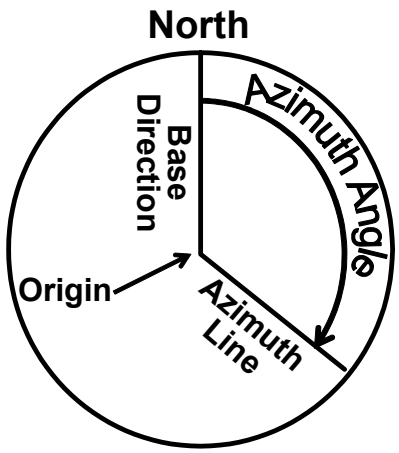


Illustration A

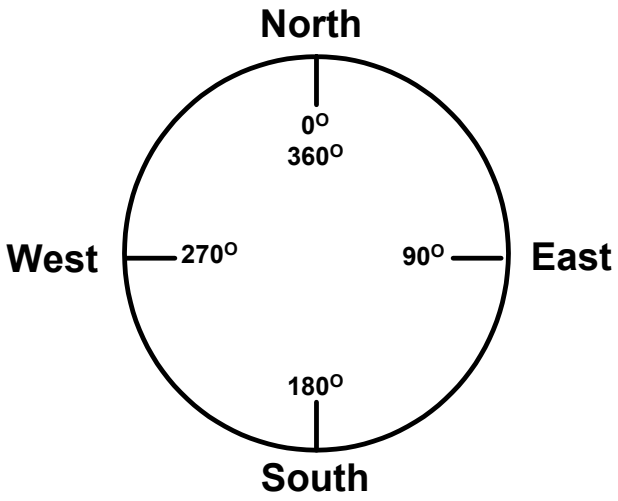
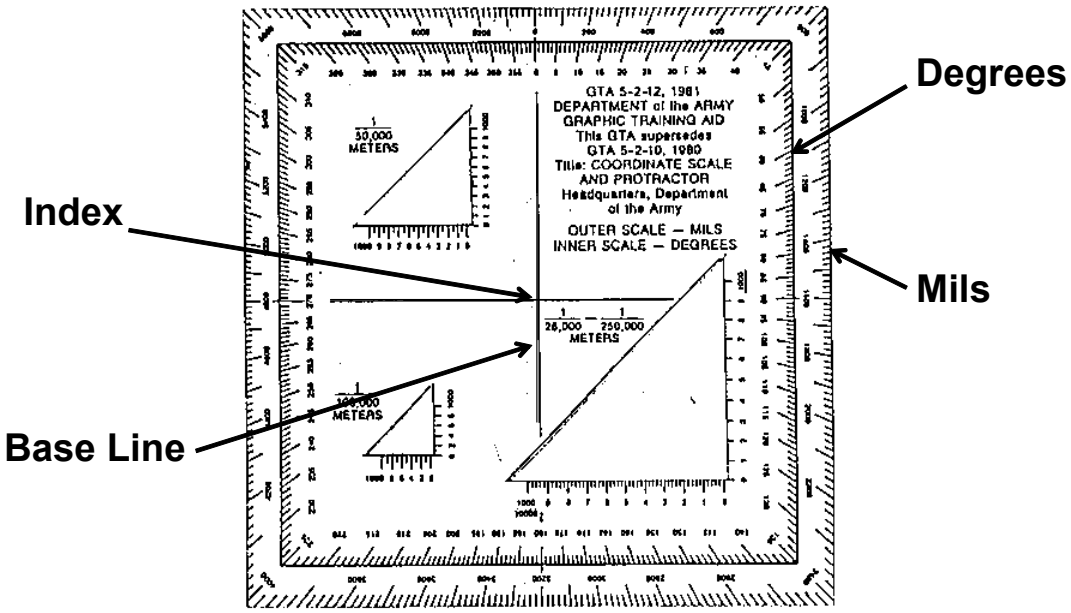


Illustration B

W221/OCT 03/VGT-10

COORDINATE SCALE AND PROTRACTOR

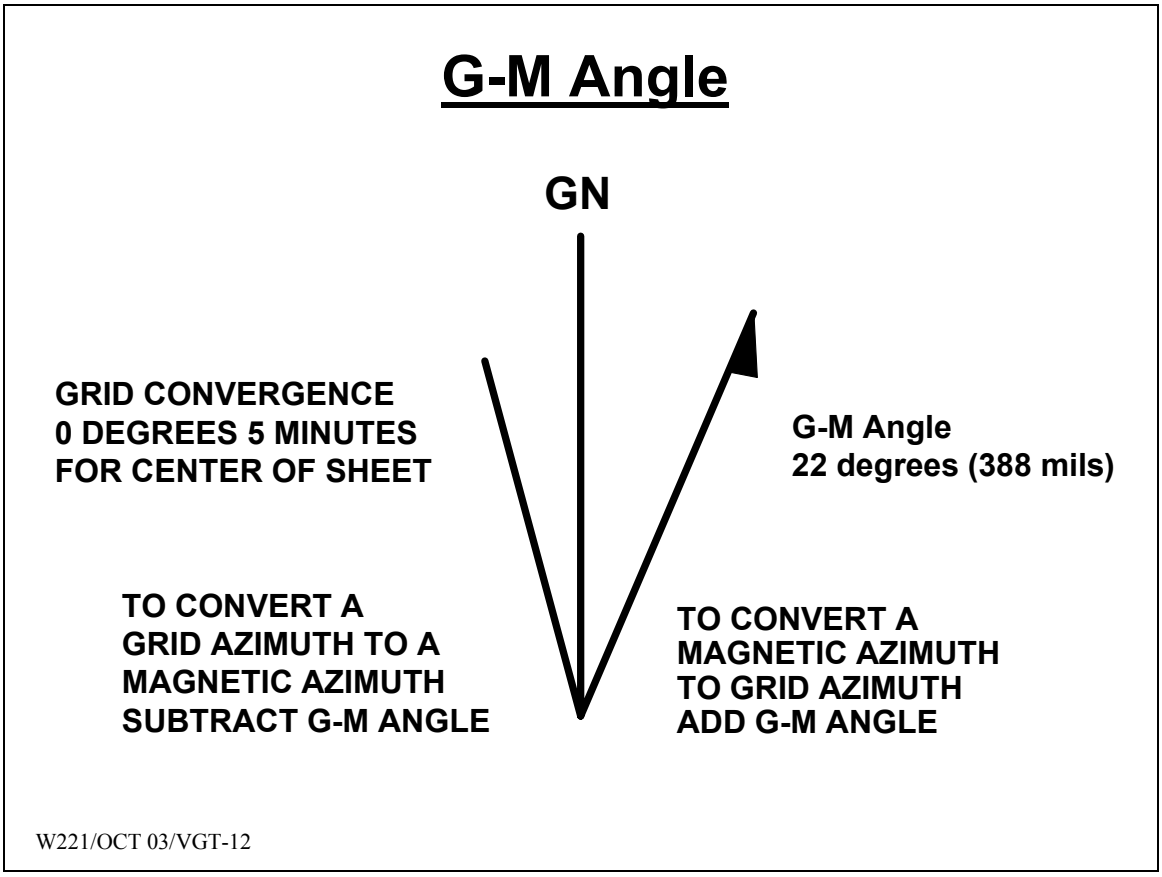


W221/OCT 03/VGT-11

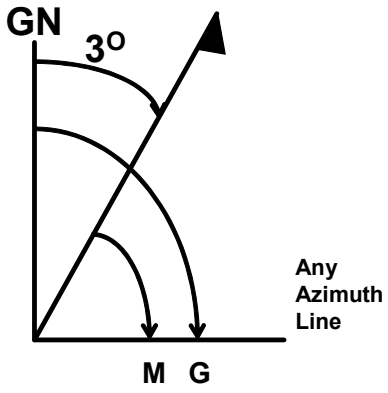
Enabling Learning Objective E

Learning Step 1

VGT-12, G-M ANGLE



Easterly



REQUIREMENT:

Convert these grid azimuths to magnetic azimuths and magnetic azimuths to Grid azimuths.

1. Grid AZ 146O
2. Grid AZ 83O
3. Mag AZ 271O

SOLUTIONS:

1. Mag AZ 143O
2. Mag AZ 80O
3. Grid AZ 274O

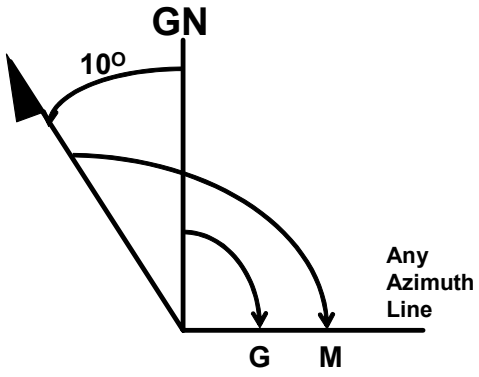
W221/OCT 03/VGT-13

Westerly

REQUIREMENT:

Convert these grid azimuths to magnetic azimuths and magnetic azimuths to grid azimuths.

1. **Mag AZ 54^{O}**
2. **Grid AZ 183^{O}**
3. **Mag AZ 216^{O}**



SOLUTIONS:

1. **Grid AZ 44^{O}**
2. **Mag AZ 193^{O}**
3. **Grid AZ 206^{O}**

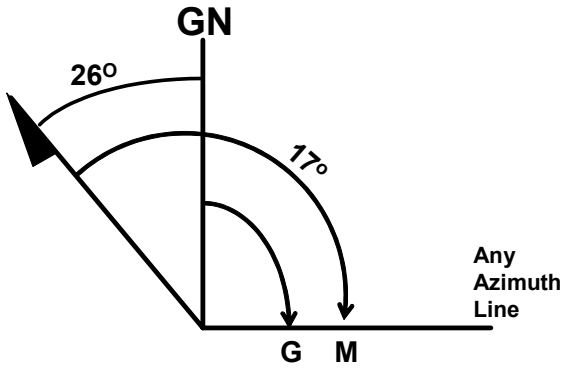
W221/OCT 03/VGT-14

Magnetic Azimuth Smaller than G-M Angle

REQUIREMENT:

Determine the Grid Azimuth of this Magnetic Azimuth.

Mag AZ 17°



SOLUTION:

Mag AZ	**17°**
	+ 360°
Total	**377°**
G-M Angle	**— 26°**
Grid AZ	**351°**

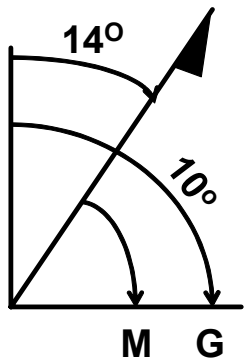
W221/OCT 03/VGT-15

Grid Azimuth Smaller than G-M Angle

REQUIREMENT:

Determine the magnetic azimuth of this grid azimuth:

Grid AZ 10°



SOLUTION:

Grid AZ	10°
+	360°
Total	370°
Minus G-M Angle	14°
Magnetic AZ	356°

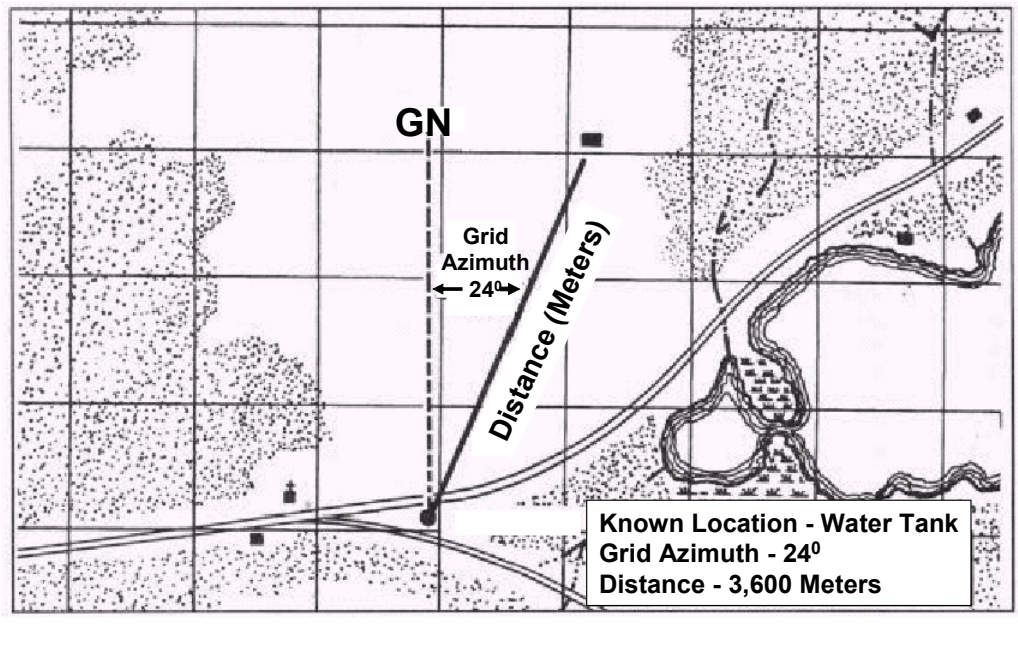
W221/OCT 03/VGT-16

Enabling Learning Objective F

Learning Step 1

VGT-17, POLAR COORDINATES

Polar Coordinate



W221/OCT 03/VGT-17

Appendix B Test(s) and Test Solution(s) (N/A)

PRACTICAL EXERCISE SHEET PE-1 (RTP)

Title

Map Reading/Land Navigation Reinforcement Training

Lesson Number/Title

W221 version 1 / Map Reading

Introduction

This practical exercise is for PLDC students to use from inprocessing to the day the NCOA teaches W221 (Map Reading), to help prepare them for the map reading and land navigation training they will receive. This PE reinforces training students received during basic training or in their units.

NOTE: The RTP is in Appendix D as SH-4.

Motivator

In order for you to successfully complete the graduation requirements of PLDC, you must be able to perform the skill level one tasks listed below. You will use these tasks in conjunction with the map reading and land navigation skills you will learn in this course. You will use these skills during the land navigation performance examination and when you lead a mission during the situational training exercise (STX), while filling a leadership position.

Terminal Learning Objective

NOTE: The instructor should inform the students of the following Terminal Learning Objective covered by this practical exercise.

At the completion of this lesson, you [the student] will:

Action:	Apply map reading skills.
Conditions:	In a classroom and field environment given a 1:50,000 Tenino map, 1:50,000 map of local training area, lensatic compass, GTA 5-2-12 (Coordinate Scale and Protractor), pencil, and paper, SH-2, SH-3, and SH-4.
Standards:	Applied map reading skills to-- • Determine elevation on a map. • Orient a map using a lensatic compass. • Determine direction on a map using a protractor. • Determine polar coordinates. • Convert azimuths using the declination diagram. • Find unknown locations on a map using intersection and resection. IAW STP 21-24-SMCT, STP 21-1-SMCT (Draft), FM 3-25.26 (SH-2), and FM 21-31 (SH-3).

Safety Requirements

IAW NCOAs SOP.

Risk Assessment Level

Low

Environmental Considerations

None

Evaluation

Not graded. The SGL will use the information gained from this exercise to enhance your map reading capabilities and skills.

Instructional Lead-In

- Students will study on their own and take the quizzes in the attached Refresher Training Package (RTP) as out of class homework covering the following tasks:

  - App C Task 2 Identify topographic symbols on a military map.
  - App C Task 3 Identify terrain features on a map
  - App C Task 11 Orient a map to the ground by map terrain association.
  - App C Task 4 Determine the grid coordinates of a point on a military map.
  - App C Task 7 Determine a location on the ground by terrain association.
  - App C Task 5 Determine a magnetic azimuth using a lensatic compass.
  - App C Task 14 Determine direction without a compass.
  - App C Task 8 Measure distance on a map.

- Students will use the first 4.5 hours of the map reading lesson to review their work on the RTP and conduct any remedial training.

Resource Requirements

Instructor Materials:

- TSP
- VGTs (17)

NCOAs will provide the students the following during inprocessing:

- Map Reading/Land Navigation Reinforcement Training Package attached to this PE.
- FM 3-25.26, Map Reading and Land Navigation, **or** SH-2.
- STP 21-1-SMCT, Soldier's Manual of Common Tasks, Skill Level One, Oct 94.
- GTA 5-2-12, Coordinate Scale and Protractor.
- 1:50,000 Tenino map.
- 1:50,000 map of the STX Training Area.
- Lensatic compass.
- NCOA developed Quiz Sheets Two, Five, and Six. (See NCOA Responsibilities on p RTP-i, para 2)

Student Materials:

- SH-1, Advance Sheet in Appendix D.
- Reinforcement Training Package in Appendix C.
- FM 3-25.26 Map Reading and Land Navigation, Jun 01 or Student Handout 2 in Appendix D.
- STP 21-1-SMCT, Skill Level 1, Appendix C (DRAFT), SH-3.
- STP 21-24-SMCT, Skill Level 2-4, APR 2003.
- Lensatic compass.
- GTA 5-2-12 Coordinate Scale/Protractor.
- 1:50,000 Tenino map.
- 1:50,000 scale map of local STX area.

NOTE: Issued to students during inprocessing.

- Pencil and writing paper.

Special Instructions

See NCOA responsibilities on the attached Map Reading/Land Navigation Reinforcement Training Package (SH-4), on p RTP-i, para 2.

Procedures	**NOTE:** The RTP and the overview and instructions are found in SH-4. The placement of the RTP as a handout is because the file was too large to fit in the PE (App C) area. • See Attached reinforcement training package. • Students will turn in their RTP quizzes to their SGL NLT 3 days prior to the start of Lesson W221 (Map Reading). SGLs will identify weaknesses and provide feedback to the students. • The first 4 hours and 30 minutes of W221 is to allow the students to review their RTPs, and work on any weaknesses they may have. • SGLs should know--by the results of the RTP quizzes--the strengths and weaknesses of each soldier and the group's over all knowledge of the Skill Level 1 Tasks. SGLs may modify the conduct of the PE by focusing on the specific weaknesses of each soldier and the group as a whole. • NCOAs will use the entire four hours and 30 minutes for the students to study and conduct hands on training of the skill level one map reading/land navigation skills listed above.
Feedback Requirements	This is a nongraded PE. However--as stated above--students will perform all tasks in the reinforcement training package (RTP) and turn in their work to their SGL. SGLs will assist soldiers in identifying any weaknesses and provide any needed remedial training. SGLs will also place the students' RTPs in their individual folders.

SOLUTION FOR
PRACTICAL EXERCISE PE-1 (RTP)

You will find the solutions to the student quizzes in SH-4, pp RTPQAS-1 thru RTPQAS-6.

This Appendix Contains

This appendix contains the items listed in this table—